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BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY. VOLUME --ETC(U)
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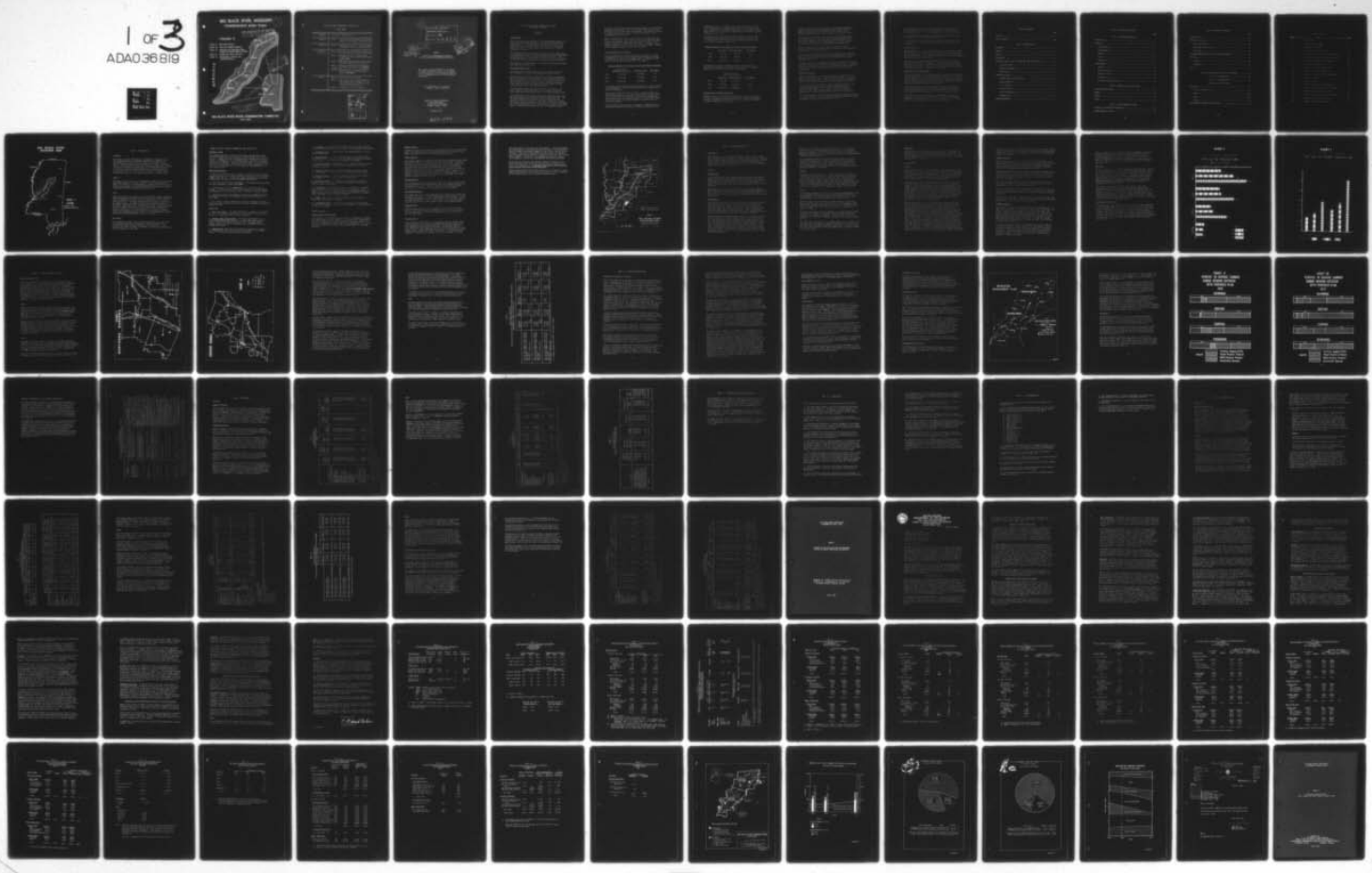

BIG BLACK RIVER, MISSISSIPPI

COMPREHENSIVE BASIN STUDY

VOLUME IV

Annex C- Recreation Aspects

Annex D- Fish and Wildlife Resources

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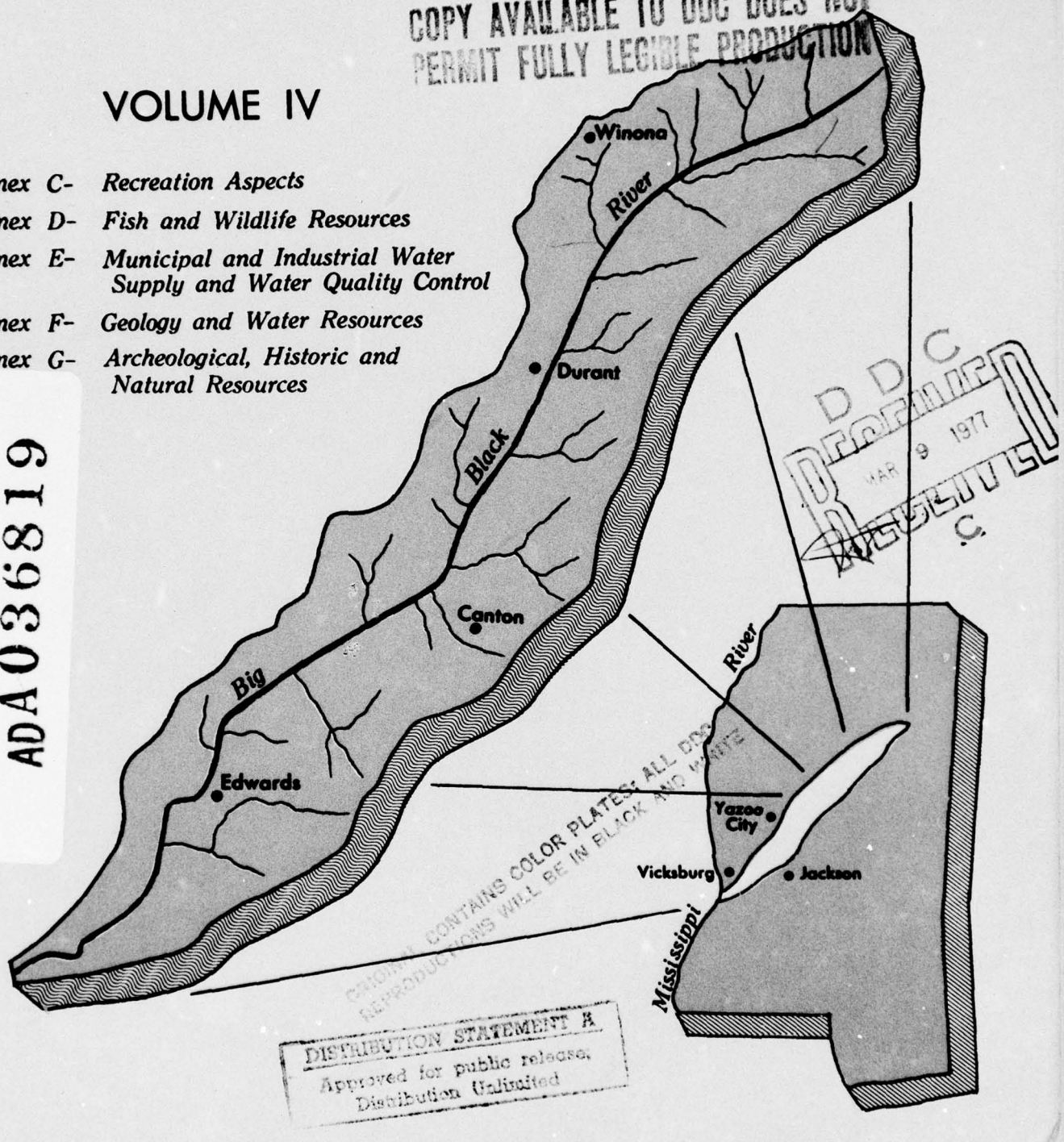

BIG BLACK RIVER BASIN COORDINATING COMMITTEE

APRIL 1968

BIG BLACK RIVER COMPREHENSIVE BASIN STUDY

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BIG BLACK RIVER, MISSISSIPPI

COMPREHENSIVE BASIN STUDY.

Volume IV.

Annex C, D, E, F, G.

(11) Dec 68

(12) 285p.

ANNEX C

A REPORT ON THE RECREATION ASPECTS
OF THE BIG BLACK RIVER BASIN, MISSISSIPPI

This report has been prepared by the Bureau of Outdoor Recreation for the ad hoc Recreation Work Group to the Coordinating Committee for the Comprehensive Study of the Big Black River Basin.

U. S. Department of the Interior
Stuart L. Udall, Secretary

BUREAU OF OUTDOOR RECREATION
Southeast Region
810 New Walton Building
Atlanta, Georgia 30303

December 1968

BIG BLACK RIVER BASIN COMPREHENSIVE STUDY
RECREATION ASPECTS

Syllabus

Introduction

This is the recreation appendix to the comprehensive study of the water and related land resources of the Big Black River Basin, Mississippi. The following report includes an analysis of the outdoor recreation demand, supply, and needs of the recreation market area and a recommended plan for development of outdoor recreation resources.

The Big Black River Basin study is one of 15 type II studies for the United States which have been scheduled by the Interdepartmental Staff Committee of the ad hoc Water Resources Council. This recreation study was conducted by the ad hoc recreation work group of the coordinating committee for the comprehensive basin study.

The study was coordinated with the Mississippi Comprehensive Statewide Outdoor Recreation Plan.

Recreation Resource Area

The Big Black River Basin drains an area of 3,400 square miles for a distance of 155 miles and averages 22 miles in width.

The northern subarea which includes part of Carroll, Montgomery, Webster, Choctaw, Attala, and Holmes Counties is rolling countryside of interspersed farms and forests. The southern subarea which consists of parts of Yazoo, Madison, Warren, Claiborne and Hinds Counties, breaks into heavily wooded and deeply incised ridges and bluffs near the Mississippi River.

The landscape is modestly scenic over most of the basin. The bluffs along the Mississippi River near the mouth of the Big Black Basin offer a spectacular view of the broad alluvial valley.

The streams frequently overflow their banks following heavy rains and often remain at this stage for extended periods of time. The forested bottomlands and adjacent terraces afford excellent habitat for various species of forest game. Hunting and fishing are popular recreation pursuits. High water, moist soil conditions, and channelized features of the stream courses, however, discourage general recreation development and use of the Big Black River.

The population residing within the basin is sparse. The rural basin population is declining. Most of the towns which serve the basin are small and located outside the watershed. Vicksburg and Jackson, the largest cities in the basin, contain 69.9 percent of the population of the study area.

Major recreation facilities located partly in the basin are the Natchez Trace Parkway, which generally follows the dividing ridge between the drainages of the Big Black and Pearl Rivers, and the Vicksburg National Military Park which forms a crescent on the heights north, east, and south of the city of Vicksburg. Farming is the principal economic activity in the basin.

Need for Recreation Opportunity

If it were feasible to develop recreation resources to a level commensurate with the needs of persons who now and are expected to reside in the basin and its market area, the demand for water based recreation would increase about five times.

Projected Demand in Recreation Days for Four Major Activities

	Activity Days Four Major Activities	Recreation Days	Per Capita
1965	2,874,300	1,900,000	6.3
1980	4,597,400	3,065,000	8.8
2015	14,873,300	10,500,000	16.9

This demand resides primarily with the population of the basin and its market area of Vicksburg and 30 percent of the population of Jackson, Mississippi.

Other factors which will have an effect on demand would be an anticipated increase in per capita income, mobility, and leisure time. Urbanization will also have the effect of transferring recreation activity from dispersed areas to developed facilities, thereby increasing the apparent demand for specific types of recreation activity.

The existing recreation supply as measured in terms of publicly owned land and water (exclusive of streams) and facilities is

inadequate to meet local needs. Most recreation travel, even for day-use opportunity, is away from the basin. There is particular need for water-based recreation opportunity in the vicinity of the small towns and the population of Jackson which is rapidly expanding westward into the basin.

An analysis of existing and programmed developed recreation areas in the study area reveals that the rated capacity involved will accommodate from about one-half million recreation days in 1965 to 6.7 million recreation days in 2015.

Projected Supply of Four Major Activities in Recreation Days

	Activities	Recreation Days	Per Capita
1965	843,192	562,130	1.9
1980	1,003,664	669,109	1.9
2015	1,003,664	669,109	1.1

A comparison of projected demand and supply clearly indicates that present inadequacy of recreation facilities to serve water-based needs will become more severe in the future.

Unsatisfied Demand

	Activities	Recreation Days	Per Capita
1965	2,031,108	1,354,072	4.5
1980	3,593,736	2,395,824	6.9
2015	13,869,636	9,246,424	14.9

Problems and Corrective Opportunity

Although there is a declining rural population with the resulting decline in demand for outdoor recreation, the increasing population residing in metropolitan Jackson will create a demand for outdoor recreation opportunity in the basin.

The land and water resource potential is presently available for limited outdoor recreation development, even though the basin generally lacks unusual alternative resources around which additional developments for outdoor recreation use may be built.

Feasibility of constructing large water resource developments on the tributaries and on the main stem of the Big Black River was considered. However, this alternative proved infeasible, even for multiple purposes. Such developments were likewise found to be too costly to develop as single purpose recreation areas.

The only practical way to obtain water suitable for outdoor recreation has been determined to be by constructing small upstream reservoirs to serve multiple needs.

Access to existing resources for outdoor recreation opportunities, such as the Mississippi River and the Big Black River, is limited, but supporting programs of State and local groups could achieve greater access.

The recreation study including the appraisal of potential resources was generally limited to water and related land resources. Coordination with the Mississippi Comprehensive Statewide Outdoor Recreation Plan was maintained to assure consideration of all recreation development.

Plan of Development

The goal of this plan is to meet as much of the outdoor recreation needs of the market area as practical at predetermined sites for water resource development. With this goal in view, a development plan for the early-action period has been formulated as follows:

1. Seventeen upstream watershed multiple-purpose reservoirs when constructed with recreation as a project purpose would have recreation development. Ten of these reservoirs would have facilities for a wide range of outdoor recreation activities, whereas seven reservoirs would have facilities for boating only.

2. Multiple-purpose reservoirs having outdoor recreation facilities for a wide range of activities would be constructed before reservoirs providing facilities for only limited activities.

3. An option with two of the above seven reservoirs would be to develop additional facilities at the time local sponsors feel local cost-sharing commitments and responsibilities could be met.

4. Recreation facilities would be increased at the Holmes County State Park and in the Tombigbee National Forest.

5. Access to the Big Black River, particularly the lower reaches, would be provided after detailed studies by the States as to site locations.

Benefits and Costs

Annual benefits that will accrue from the 10-15 year recreation plan are $950,000. This estimate is based on outdoor recreation development to accommodate 750,000 recreation days annually. In addition, the proposed bodies of water may be considered as offering an aesthetic experience having intangible value.

Cost of the 17 multiple-purpose structures proposed in the early-action recreation plan is $6 million. The cost of these projects allotted to recreation, including recreation facilities to be constructed, is $3 million. The cost of the two single-purpose projects in the 10-15 year plan is approximately $600,000.

Discussion and Recommendations

The plan of development for outdoor recreation would meet 58 percent of the total demand. This demand would be met mainly at the proposed multiple-purpose water resource improvements. The Big Black River Basin, although it affords good sites for water resource development, does not have generally well recognized natural resources that lend themselves to outdoor recreation development.

A balanced outdoor recreation development program will require a greater consideration of a balanced land and water use program. In long range development, more intensive development of the created resources will provide for increasing outdoor recreation needs.

The 10-15 year plan of development is recommended by the ad hoc Recreation Work Group of the Big Black River Basin Coordinating Committee, as presented in this report for adoption as an integral part of the Big Black River Basin Comprehensive Plan.

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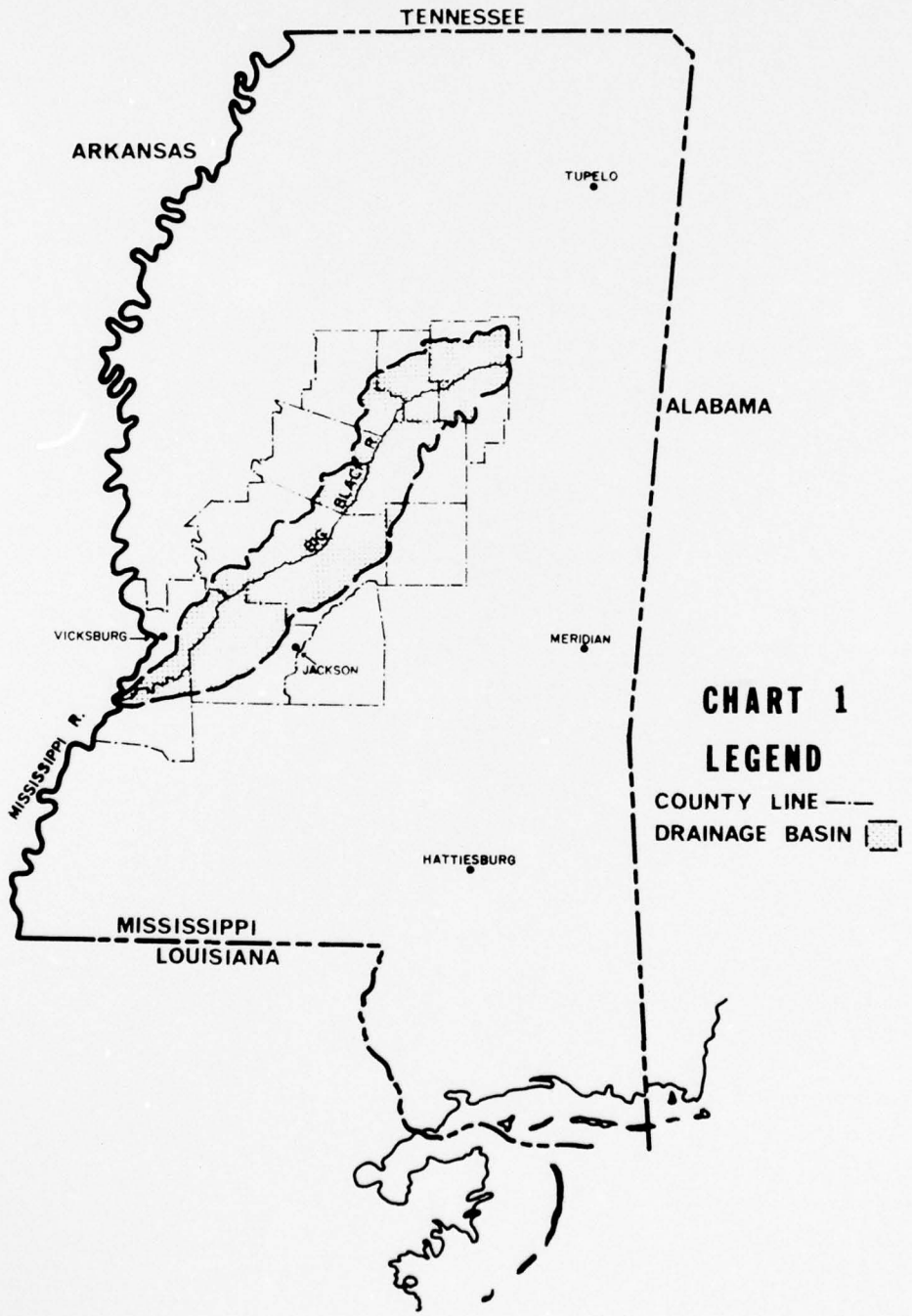
LOCATION MAP



PART I - INTRODUCTION

AUTHORITY

The Bureau of Outdoor Recreation is authorized to engage in water and related land resource programs through the Coordination and Development Act of May 28, 1963 (77 Stat. 49; 16 U.S.C. 460 et seq.). The Federal Water Project Recreation Act (Public Law 89-72; 79 Stat. 213) requires that the views of the Secretary of the Interior, with respect to outdoor recreation, be set forth in any report on a project or parts of a project within the provisions of the Act, in accordance with Section 3 of 77 Stat. 49 and the Land and Water Conservation Fund Act of 1965 (Public Law 88-578 ; 78 Stat. 897.)

PURPOSE

The purpose of this study is to determine the impact of water resource development projects on outdoor recreation in the Big Black River Basin. In addition, the study presents a general plan for the outdoor recreation development of identified water and related land resources through which outdoor recreation needs may be met.

SCOPE

This study includes an inventory of existing public outdoor recreation areas encompassing recreation activities grouped into three categories: (1) those dependent on water; (2) those enhanced by water; and (3) other activities. Particular emphasis has been placed on determining the demand, supply, and needs of the outdoor recreating public in the basin; appraising outdoor recreation potentials of identified water and related land resources, both public and private; evaluating the extent of early-action and long-range water resource development programs with respect to their potential to meet outdoor recreation needs; and recommending specific action to meet the demand for outdoor recreation activities within the next 10 - 15 years.

BACKGROUND

The comprehensive study of the Big Black River Basin was authorized by resolutions adopted by the Committee on Public Works of the United States House of Representatives in 1951 and 1957. It was initiated in fiscal year 1964. The Bureau of Outdoor Recreation began its participation in July 1964.

PLANNING CONCEPT, PLANNING ASSUMPTIONS, AND DEFINITIONS

Planning concept

The planning approach is based on the concept that the aim of water and related land resources programs is to satisfy human needs and desires. Outdoor recreation, possessing both tangible and intangible values, is considered to be a desirable product of water and related land resources programs. Planning principles used in the formulation, evaluation, and review of recreation plans on water projects are set forth in Senate Document No. 97, 87th Congress, and Supplement No. 1, dated June 4, 1964.

Planning assumptions

1. Basin participation rates for outdoor recreation activities were derived from data in the Outdoor Recreation Resources Review Commission (ORRRC) Report No. 19. Hunting and fishing participation rates were determined by the Bureau of Sport Fisheries and Wildlife.

2. Such rates bear a direct relationship to per capita personal income and can be adjusted for particular areas.

3. Participation rates from ORRRC Report No. 19, which refers to persons "12 years old and older," may be applied to total populations assuming much outdoor recreation activity involves the entire family.

4. Population and per capita personal income projections will follow the pattern developed by the Economic Base Study of the Big Black River Basin.

5. All outdoor recreation demand will initiate from within the Big Black River Basin study area and from the Jackson Standard Metropolitan Statistical Area.

Definitions

1. Activity occasion: The participation by one person in one activity in 1 day. If a person participated in three different activities in 1 day, it is counted as three activity occasions.

2. Average summer Sunday demand: The average participation on a normal summer Sunday calculated on a 13-week summer basis with 40 percent of weekly recreation assumed to occur on Sunday, except camping, where 75 percent of the weekly use is assumed to occur on Saturday and Sunday.

3. Comprehensive: When used with "outdoor recreation" it refers to all activities dependent upon an outdoor environment. With "river basins," it refers to multiple-purpose development.

4. Programmed: An approved and financed schedule of events effectuating a development plan or project within the forthcoming 5-year period.

5. Recreation area: A land or water area administered as a unit for outdoor recreation.

6. Recreation day: A visit by one individual to an outdoor recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period measured from midnight.

7. Recreation demand: A measurement of the outdoor recreation opportunities or facilities the public desires, expressed in terms of activity occasions.

8. Recreation Market Area: The area from which people are drawn on 1-day outings or weekend trips to the area under consideration.

9. Recreation needs: Unsatisfied demands translated into resource requirements in terms of land, water, and facilities.

10. Recreation supply: The capacity of resources and facilities capable of providing outdoor recreation opportunities expressed in terms of activity occasions.

11. Related land: Land on which present or projected use or management practices cause significant effects on the quantity and/or quality of the water resources and the use or management of which is significantly affected by existing and proposed measures for management, development or use of water resources.

12. Summer: The summer period is considered to be the months of June, July, and August, or 13 weeks.

13. Unsatisfied demand: The difference between outdoor recreation demand and the capacity of existing and programmed resources, expressed in activity occasions.

PLANNING CRITERIA

Average Summer Sunday Demand

This demand for all activities except camping is computed by dividing the summer demand for each activity by 13 (based on a 13-week summer period) and multiplying by 0.40 to determine the Sunday demand. In the case of camping, the weekly demand is multiplied by 0.75. Facility needs for various activities are then computed using the following criteria.

Camping Capacity

Camping facilities are planned with one campsite per acre of undeveloped land. The camping capacity of fully developed land is based on three family units per acre with five persons per family unit.

Picnic Capacity

Daily picnic capacity is based on five persons per table and seven tables per developed acre. A turnover of two per table is used. For land acquisition, a figure of two tables per acre can be used. Computation of picnic activity occasions per developed acre is accomplished by multiplying the total number of persons and tables per acre by the turnover: 5 persons x 7 tables x 2 = 70 picnic activity occasions per developed acre; for acquisition of undeveloped land, 5 persons x 2 tables x 2 = 20 picnic activity occasions per undeveloped acre. Individual site characteristics may necessitate the planning of a lesser number of tables per developed acre.

Boating Capacity

Daily boating capacity is based on one boat per 6 acres of water, with an average party of three persons per boat. For planning purposes, no turnover factor is used. However, individual site characteristics may necessitate the use of the turnover factor in some areas.

Boat Launching Areas

Boat ramps with access roads, maneuvering and parking space, should be planned on the basis of 2 acres of undeveloped land per ramp. In terms of maximum development, one ramp with parking for 40 cars and trailers requires approximately 1 acre. There should be one launching ramp for each anticipated 40 cars and trailers on the average summer Sunday.

Swimming Areas

Swimming areas require 2 acres of parking and 1 acre of beach and water for each 200 swimmers. Assuming a turnover of three, each acre of beach and water will support 600 swimming activity occasions per day (3 x 200 = 600).

ACKNOWLEDGMENTS

Data included in this report on the existing supply of outdoor recreation facilities were obtained from Nationwide Inventory Forms (BOR 8-73) submitted by the following agencies: Mississippi Game and Fish Commission, Mississippi Park System, National Park Service, U.S. Forest Service, Canton Park Commission, Yazoo City Department of Parks and Recreation, Vicksburg Recreation Department, and Kosciusko Park Commission. Mississippi's liaison officer to the Bureau of Outdoor

Recreation was the focal point for the inventory. The Area Redevelopment Administration contributed by making available the publication Overall Economic Development Program for many of the counties within the basin. Information furnished by various chambers of commerce and by the National Association of Conservation Districts was utilized where possible. Information on programmed and potential projects was furnished by Federal and State agencies previously mentioned.

Projections of population and personal income for the basin were based on Economic Base Study data developed for interagency use by the Corps of Engineers in its Economic Base Study of the Pascagoula, Pearl, and Big Black River Basins Study Area.

Federal agencies assisting in field surveys were the Bureau of Sport Fisheries and Wildlife, Soil Conservation Service, Corps of Engineers, and the Federal Water Pollution Control Administration.

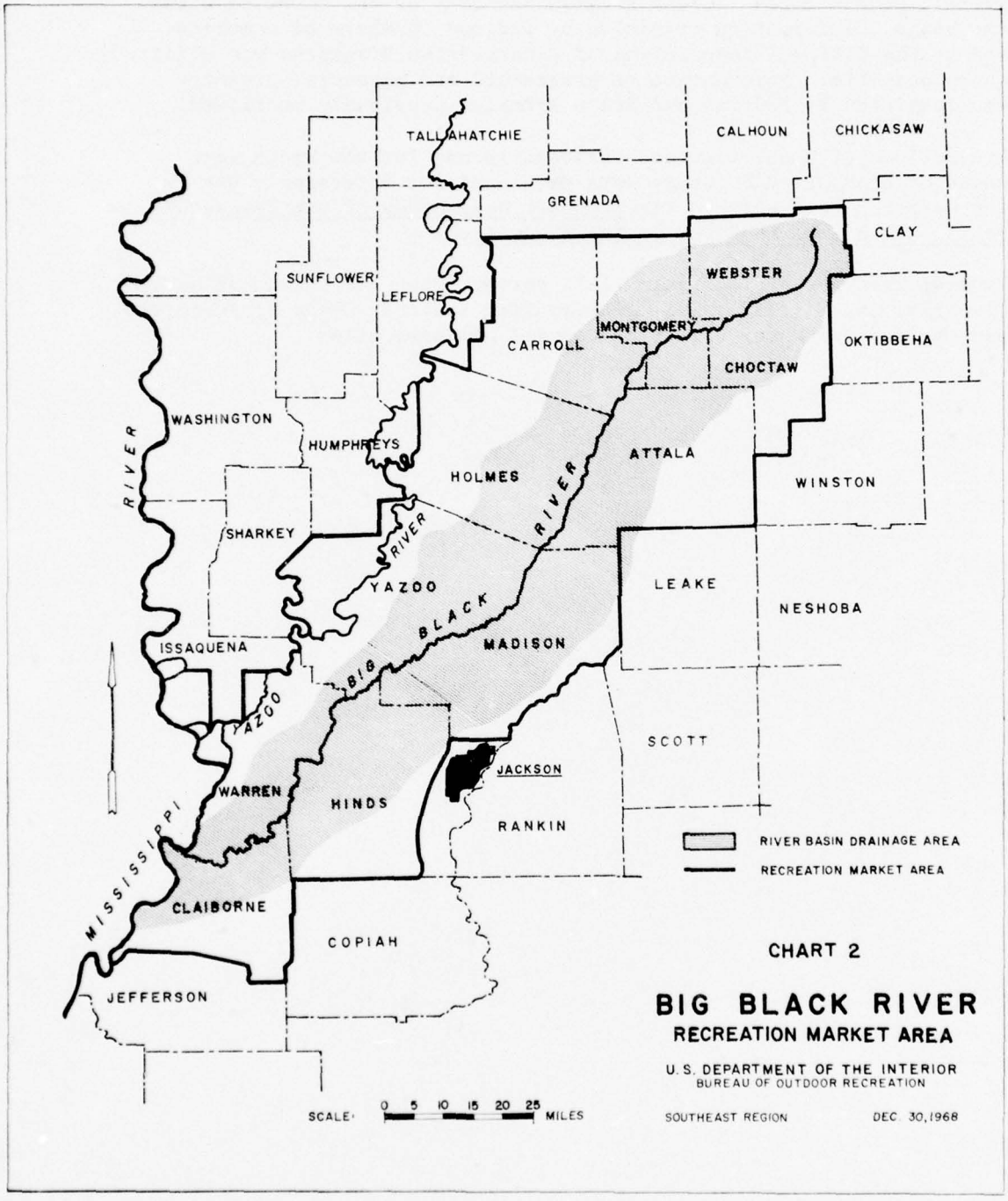


CHART 2

BIG BLACK RIVER
RECREATION MARKET AREA

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION

SOUTHEAST REGION DEC. 30, 1968

PART II - GENERAL DESCRIPTION

INTRODUCTION

The study area in west-central Mississippi comprises 6,637 square miles and includes 10½ contiguous counties; Attala, Carroll, Claiborne, Choctaw, Holmes, Madison, Montgomery, Warren, Webster, Yazoo, and the western part of Hinds County. Parts of the North Central Hills, Jackson Prairie, Long Leaf Pine Hills, and Loess Bluff physiographic regions are included. (See Chart 2.)

PHYSICAL

Drainage Area

The Big Black River Basin, draining 3,400 square miles, is approximately 155 miles long and averages 22 miles in width. The major stream is the Big Black River which rises in Webster County in north-central Mississippi and flows in a southwesterly direction. It enters the Mississippi River near Grand Gulf, about 25 miles south of Vicksburg.

Flood plains of the Big Black River and its tributaries comprise about 22 percent of the basin, with the remainder being highlands and hill slopes. The channel of the river in the headwater region is small, but within the first 55 miles it increases in size to a width of 250 feet.

Physiography

The Big Black Basin lies in the Coastal Plain Province, within which four physiographic divisions cross the basin in a northwesterly direction. From the oldest to most recent and in a downstream direction, these are: North Central Hills, Jackson Prairie, Long Leaf Pine Hills, and Loess or Bluff Hills. These divisions are reflected in topography, kind and composition of underlying material and, to a degree, in soils and type of vegetation present.

The North Central Hills physiographic division is a broad sand hill upland dissected by numerous stream valleys. The Jackson Prairie is a rolling landscape with relatively wide stream bottoms. The Long Leaf Pine Hills, in the extreme southeast portion of the basin, is a broad upland area well dissected by numerous streams. Topography is gently sloping to steep with many wide ridgetops. The Loess or Bluff Hills, lying in the southwest portion of the basin, is a steep upland area dissected by relatively deep gorges. Windblown silt 50 feet or more thick is deposited near the bluffs along the Mississippi River.

Physically, the northern subarea of the basin is more conducive to water resource development because sites suitable for impounding water are available. The Big Black River and major tributaries are generally small and do not offer many opportunities for water-dependent and water-enhanced recreation.

In the southern subarea, the Big Black River is wider and has the flow and depth necessary to support some boating. Also, some of the larger tributaries are used for boating. Some good reservoir sites can be found in this area; however, these would have to be mostly single-purpose reservoirs because of the backwaters from the Mississippi River in flood times.

Climate

The basin, with an average of 225 frost-free days, has a climate conducive to outdoor recreation. Winter temperatures average about 51°F., while the average for the summer is 79°F. Annual rainfall averages around 52 inches, with the wettest period occurring in March. The basin's summer climate lends itself to outdoor recreation except for limited periods. The spring, fall and winter seasons are mild and offer frequent opportunities for outdoor activities under a bright hot sun which at this latitude is intense even in winter.

Soils

Corresponding roughly in location to the geologic physiographic areas are Land Resource Areas which are physical groupings based on soil and topography. The Big Black Basin falls largely into the Upper Coastal Plain, Thin Loess, and Brown Loam or Thick Loess.

The Upper Coastal Plain comprises the upper reaches of the basin with topography ranging from almost flat in the bottomlands to very steep in the uplands. The majority of the land is wooded but where slopes are gentle and soil conditions favorable, a general type farming is done.

The Thin Loess Resource Area is adjacent to the Upper Coastal Plains. Topography is rolling to steep with certain sections around the perimeter being rugged. Bottoms are relatively wide and are used extensively for row crops. Uplands are used largely for pasture and forest.

The Brown Loam or Thick Loess is a rugged upland area of narrow ridge-tops and steep side slopes. A mantel of windblown silts, 50 feet or more thick near the Mississippi River Bluffs and thinning out toward the east, covers the area. The more rugged parts are densely covered with hardwood trees.

Vegetation

The entire basin was formerly covered by a forest of shortleaf and loblolly pine on the hills and mixed hardwoods in the valleys. It is mainly cut over at the present and large parts are now in cultivation or abandoned to erosion and scrub oak second growth. Pines are being planted in some areas.

SOCIOECONOMIC

History

Mississippi's rich historical background, particularly of the antebellum era, has become well-known beyond the State's boundaries and is an important source of income for those businesses which cater to tourists. Mississippi's recorded history dates back more than 300 years before the great plantations and over 50 years before the first colonists landed in Virginia and Massachusetts.

The Spanish, French, and British competed for control of the rich Lower Mississippi Valley and left their marks on its culture and economy. In 1541, when the Spanish explorer Hernando DeSoto first looked upon the Mississippi River (near the present northwest corner of the State), three major Indian tribes occupied the present day Mississippi--the Chickasaw in the northeast, the Choctaw in the south, and the Natchez in the southwest. Smaller tribes also lived in this area. Like most North American Indians, these tribes kept busy with war, hunting and fishing, and simple crop cultivation. The Natchez, however, had a culture somewhat similar to that of some Indians of Mexico and South America.

The French explored the area during the latter years of the 17th century and in 1699 established the first permanent white colony in the Lower Mississippi Valley at the present location of Ocean Springs. Later, the French settled at Biloxi, Natchez, and Pascagoula. British efforts at colonization began after 1763 when French Territory east of the Mississippi River, given to Spain the prior year, was granted to Great Britin by the Treaty of Paris. Fort Rosalie at Natchez was rebuilt and an English migration to this area remained loyal to Great Britin during the American Revolution and for that reason many Loyalists left the American Colonies for Natchez. Spain reestablished its authority in 1779, and Spanish civil and military governors ruled the Natchez District until 1798 when American troops occupied Natchez and raised the American flag. That same year Congress created the Mississippi Territory, with its capital at Natchez. In 1802, the capital was moved to Washington, 6 miles to the east. On December 10, 1817, the territory became the 20th State of the Union with a site near LeFleur's Bluff on the Pearl

River selected for the new State capital and named for Andrew Jackson, the hero of the Battle of New Orleans. In January 1861, Mississippi became the second State to secede from the Union and was readmitted to the Union in 1870.

Historical Areas

The Natchez Trace, an area of major historical significance, falls partly within the study area. The trace had its beginning as several Indian trails but emerged around 1800 as an important wilderness road extending from Natchez, Mississippi, to Nashville, Tennessee. Its period of heaviest use was between 1800 and 1820.

The National Park Service is developing a parkway, approximately one-half completed, following roughly the route of the old trace. Recreation areas providing camping and picnic facilities are located adjacent to the parkway and specific areas of historical interest have been developed or marked.

The Vicksburg Battlefield, an area of a major Civil War battle, has also been developed by the National Park Service and is presently accommodating almost a million visitors a year.

The State of Mississippi has developed and preserved the site of the Battle of Grand Gulf about 25 miles south of Vicksburg. In addition, an old cemetery dating back many years before the Civil War has been preserved.

An event that has become a legend in America is the Casey Jones train wreck in 1900. The site of this wreck is at the small town of Vaughn, Mississippi, not far from the Big Black River.

Economic Activity

Land in the basin has been classified by the U.S. Department of Agriculture as follows: 57 percent is forest land; 23 percent, cropland; 13 percent, pasture land; and 7 percent, other land. The number of farms has been steadily declining due to consolidation brought about by changing agricultural methods. This decline has been accompanied by the exodus of families to urban areas to find employment in nonagricultural industries. Although the average size of farms is increasing, small commercial farms still dominate the agricultural picture.

In terms of production, corn is the leading crop in the number of acres harvested in the basin. Cotton is second; however, acreage has been declining for several years and is expected to continue to decline. The acreage devoted to the production of soybeans is increasing. Interspersed open and wooded lands throughout the basin has offered a wide range of opportunities from driving for pleasure to hiking and hunting.

Industrial development is expected to increase somewhat, especially in the vicinity of Jackson, thus reflecting urbanization and the accompanying needs for recreation. A small amount of industry is located at Vicksburg, Yazoo City, and Kosciusko. These include those producing lumber products, portland cement, lighting fixtures, furniture, school bus bodies, nitrogen fertilizer, heavy equipment, and mobile homes.

Population

Prior to World War I, the basin's population was increasing. However, by 1920, it showed a decline. The basin had almost recovered this loss when World War II occurred, and its population tumbled back to less than the pre-World War I level. The downward trend continued and in 1960 there were 241,900 people in the basin, slightly less than the number 70 years earlier. Since 1940, the basin has also experienced a heavy out-migration of population due to shrinking worker requirements in agriculture and the lack of industrial development to offer employment.

Basin population declined 9 percent from 1950 to 1960, while Vicksburg and Yazoo City gained 4 and 15 percent, respectively. Only Warren County and western Hinds County have enjoyed population expansion since 1940. It is estimated that the agriculturally-oriented population will continue to decline for some years. After a drop in population to an estimated 235,400 for the basin in 1965, projections show a slight reversal to 248,500 in 1980 and a continuing increase to 379,000 by 2015 (see Chart 3).

Per Capita Personal Income

The average per capita personal income for the basin area, although it has risen from $840 in 1950 to $1,139 in 1960, is well below the national average of $1,850. Nine of the basin counties ranked among the bottom 10 percent and the other two were below the national average. Based on the assumption that income reflects participation in outdoor recreation activities, it is expected that participation will increase as the per capita income increases due to major expansion in industrial payrolls and other diversified economic development. (see Chart 4).

CHART 3

BIG BLACK RIVER BASIN and JACKSON SMSA

POPULATION PROJECTIONS

POPULATION IN THOUSANDS

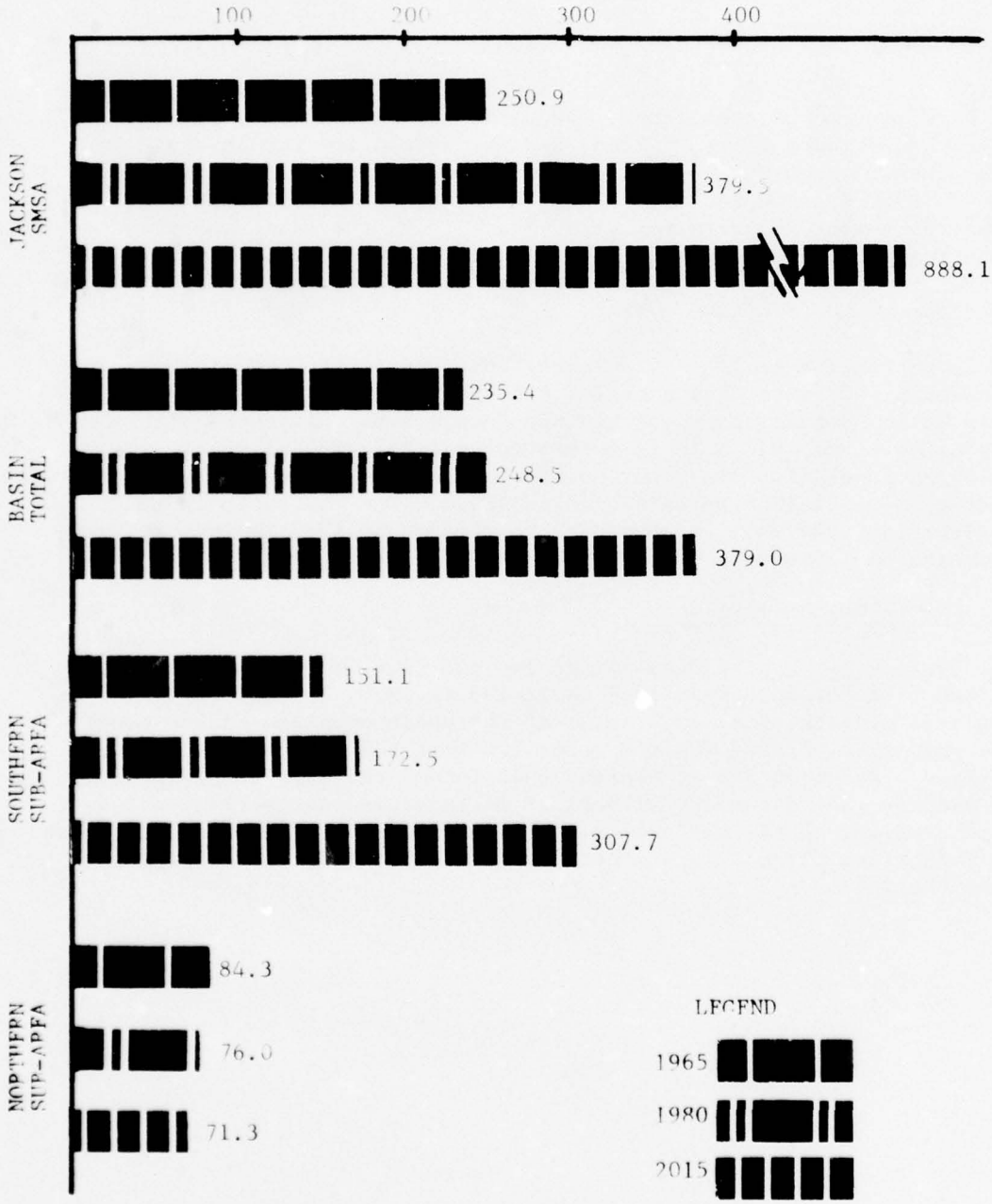
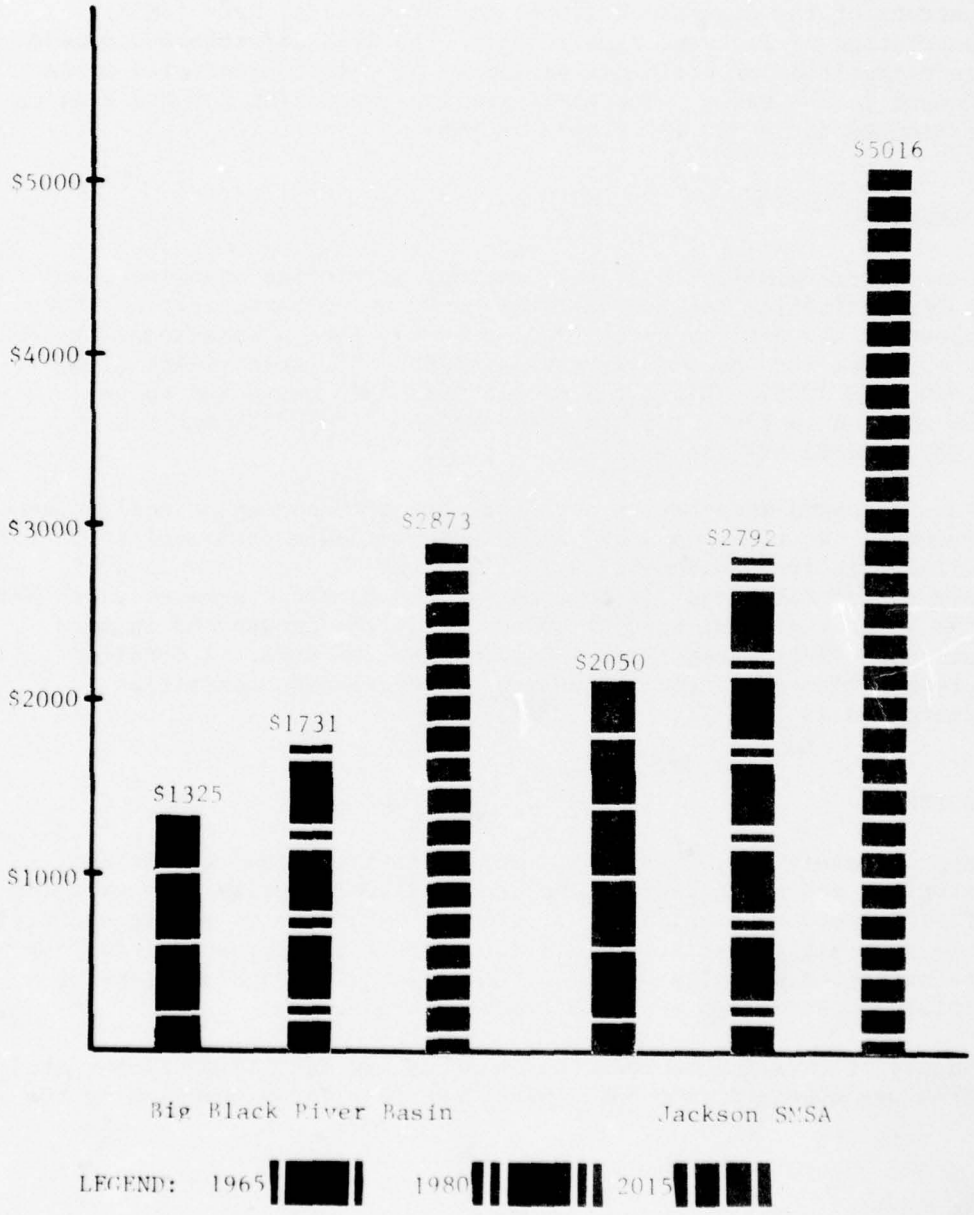


CHART 4

Big Black River Basin and Jackson SMSA

PER CAPITA INCOME PROJECTIONS



PART III - DEMAND, SUPPLY, AND NEEDS

RECREATION MARKET AREA

To establish a basis for formulating a recreation plan for the basin, a market area was delineated which was judged to represent that area from which 80 percent of the demand for recreation opportunities within the basin would originate. The market area employed in this analysis consists of the 10½ contiguous counties shown on Chart 2 and contained in the study area, including 30 percent of the Standard Metropolitan Statistical Area (SMSA) population of Jackson, Mississippi. The SMSA adjustment was made in recognition of the close proximity of this concentrated urban demand to the basin. The participating population for the area is estimated to be 300,100 people in 1965.

DEMAND

Demand for swimming, boating, camping, picnicking, canoeing, and other activities has been determined by using participation rates shown in the Outdoor Recreation Resources Review Commission Study Report No. 19. Demand was estimated for the target years 1965, 1980, and 2015. This total annual demand is estimated to be 16 million in 1965, and has been projected to be 25 million in 1980, and 82 million in 2015.

Annual demand in activity occasions for the four major activities--swimming, boating, camping, and picnicking--was estimated to be 1.8 million in 1965, 4.6 million in 1980, and 16.0 million in 2015. Demand for recreation is greatest in the southern subarea which has the largest present population and projected growth and is considerably influenced by the adjacent Jackson SMSA. A detailed presentation of demand by subarea and recreation activities is contained in Part IX.

SUPPLY

Approximately 850,000 activity occasions for swimming, boating, camping, and picnicking can be accommodated annually with existing facilities. By considering programmed expansion on public recreation areas, 1 million activity occasions for these four activities can be satisfied annually by 1970. Chart 5 and 6 show locations of existing recreation areas by basin subareas.

Supply of existing recreation resources and facilities in the study area was obtained from Nationwide Inventory Forms compiled by the

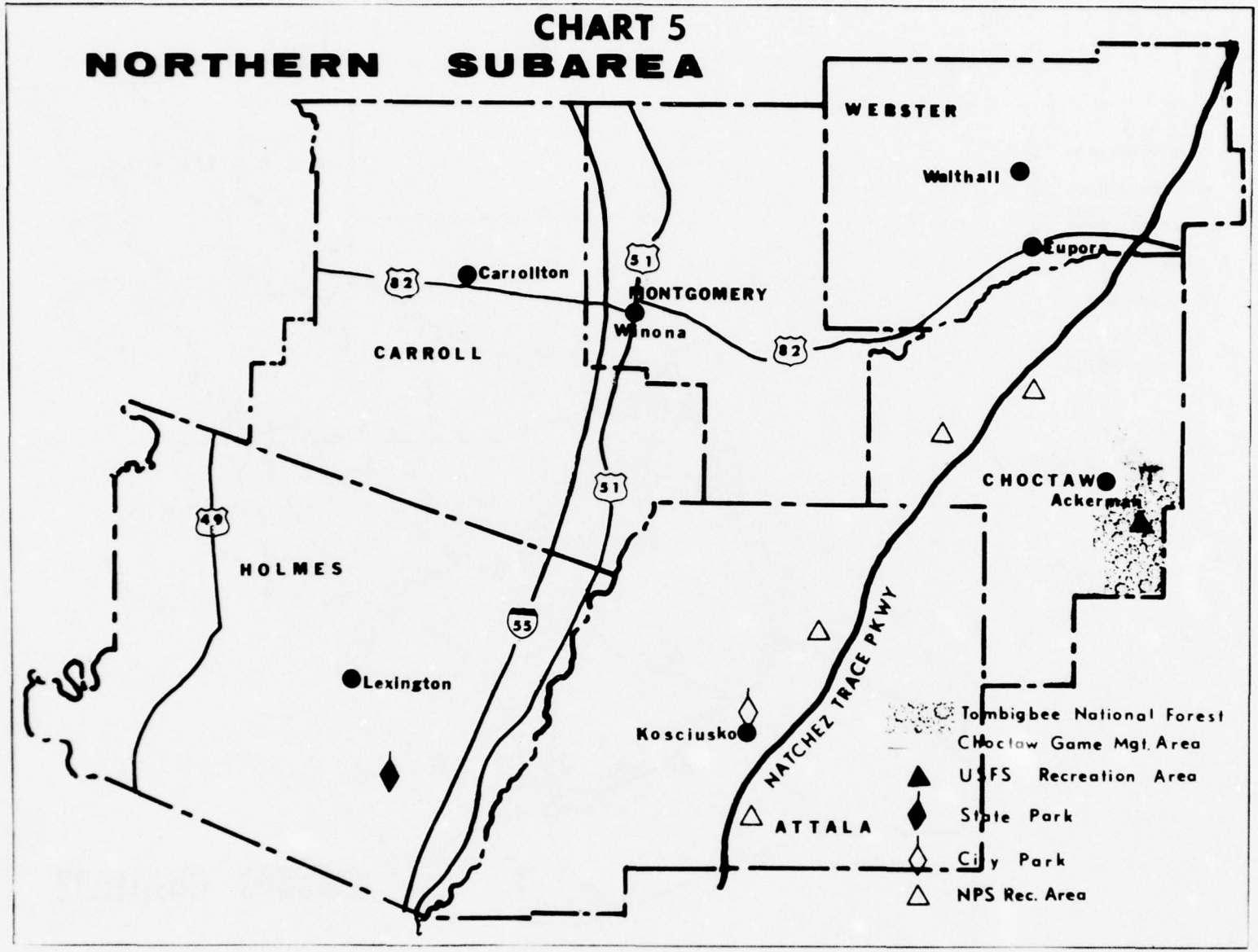
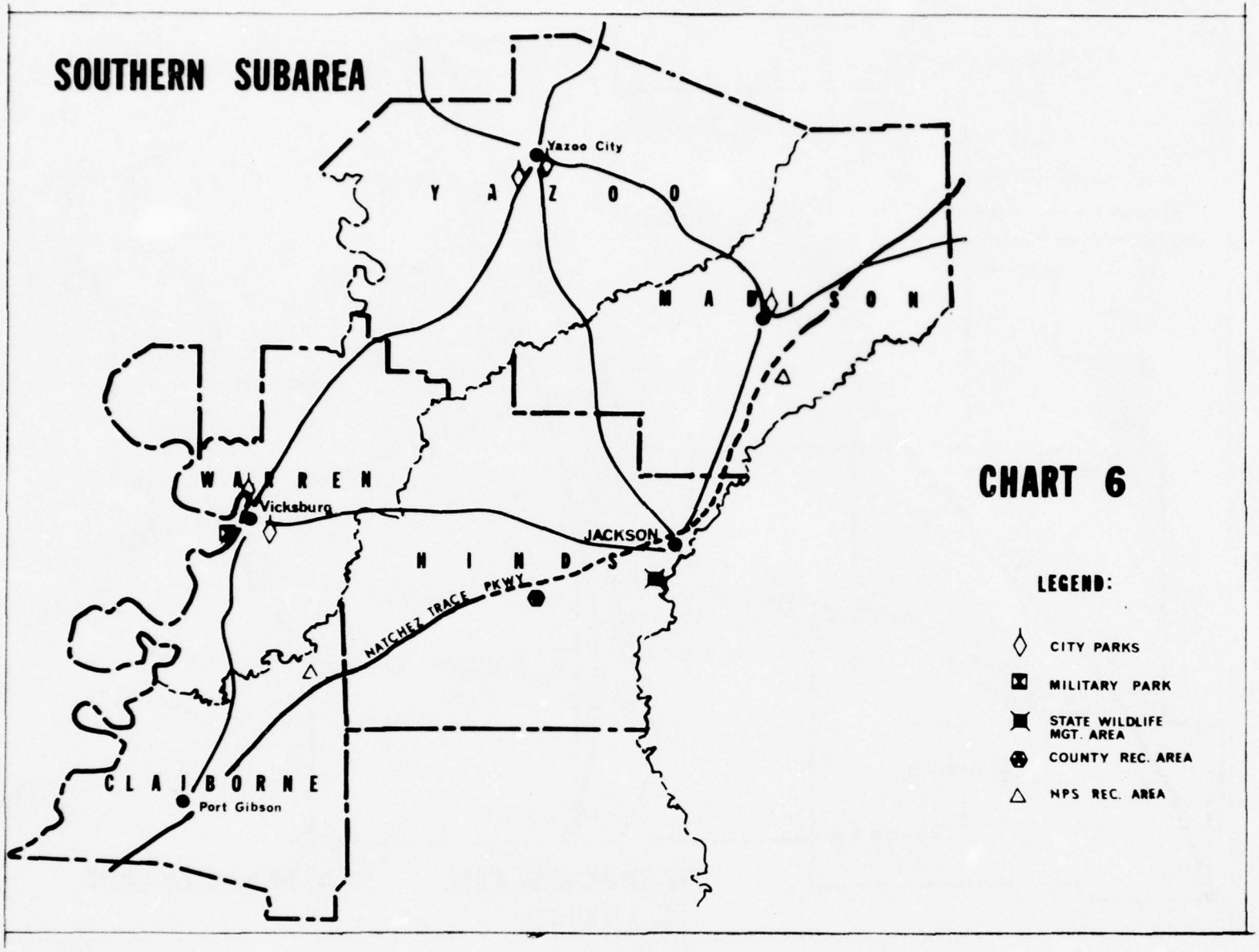


CHART 5
NORTHERN SUBAREA
WEBSTER
Walthall
Eupora
82
Carrollton
51
MONTGOMERY
Winona
82
CARROLL
51
CHOCTAW
Ackerman
49
HOLMES
55
Lexington
Kosciusko
NATCHEZ TRACE PKWY
ATTALA
Tombigbee National Forest
Choctaw Game Mgt. Area
USFS Recreation Area
State Park
City Park
NPS Rec. Area


SOUTHERN SUBAREA
Yazoo City
Y A Z O O
M A D I S O N
W A R R E N
Vicksburg
JACKSON
H I N D S
NATCHEZ TRACE PKWY
C L A I B O R N E
Port Gibson
CHART 6
LEGEND:
CITY PARKS
MILITARY PARK
STATE WILDLIFE MGT. AREA
COUNTY REC. AREA
NPS REC. AREA

Bureau of Outdoor Recreation. Private supply data were taken from the inventory compiled by the National Association of Conservation Districts for Mississippi. Presently programmed additions to public recreation facilities were considered and added to the 1965 supply to obtain the 1970 supply.

Few of the counties in the study area presently have adequate recreation faciiities. The areas in the basin accommodating most of the recreation use are the Natchez Trace Parkway, the Holmes County State Park, the Tombigbee National Forest, and the Choctaw Wildlife Management Area. The Vicksburg National Military Park receives almost 1 million visitors a year, but general recreation facilities, such as picnic tables or camping areas, are not provided. Although canoeing water is in adequate supply, access to this water and land for campsites is needed along the rivers and streams.

The largest amount of public recreation land is found in the northern subarea, mostly in the Choctaw County portion of the Tombigbee National Forest and the Choctaw Wildlife Management Area. Only a small percentage of the public recreational land in the study area provides water oriented opportunities. Grenada Reservoir is about 15 miles from the Big Black River Basin study area, while Enid and Sardis are about 40 and 55 miles away, respectively. Ross Barnett Reservoir, just north of Jackson, is 15 miles east of the basin. These reservoirs all offer various degrees of outdoor recreation opportunity.

The Yazoo River study, recently completed by the Corps of Engineers, includes recreation as a project purpose. Planned recreation facility development recommended as part of the project will accommodate 1.5 million activity occasions annually for swimming, boating, camping, and picnicking. The project would provide a 3,000-acre navigation pool in Warren and Yazoo counties that could be developed for outdoor recreation use.

The operation of Sardis, Enid, and Grenada reservoirs will be modified to provide for additional storage of water and enhancement of recreation opportunity. At Sardis, an additional 83,000 annual recreation days are expected by 1975. Modification would permit addition of new public-use areas and allow considerable expansion of existing areas. Modification of Enid Reservoir with the navigation project would provide an average of about 5,000 surface acres of additional water during the recreation season. On Grenada Reservoir, modification would result in a significant increase in the acreage of water available during the recreation season. An average of about 13,500 surface acres of additional water would be available during the months of May through September.

On Enid and Grenada reservoirs, additional water would accommodate about 9,000 more boating activity occasions daily, and nearly 600,000 more boating activity occasions annually. Considering that these two reservoirs, particularly Grenada, are presently used by residents of the Big Black River Basin, modification in operation could have a significant effect on providing additional boating opportunities to basin residents. The quality of water-dependent recreation on these three reservoirs would be improved as modification will provide better natural beaches, sheltered creek embayments, and boat access.

In addition to these reservoirs, the Mississippi River is an outdoor recreation resource in itself. Access to the river would require improvement of facilities for the type of recreation expected.

NEEDS

Existing needs are the demand for outdoor recreation opportunities less the present capacity of existing resources and facilities. Projected needs are the difference between projected demand and projected supply. Needs are the same as unsatisfied demand translated into resource requirements of land, water, and facilities.

Need exists in 1965 for facilities to accommodate approximately 2 million activity occasions annually for the major activities of boating, swimming, camping, and picnicking. This need, which is greatest in the southern subarea, is expected to increase to 3.5 million activity occasions in 1980, and to 14 million in 2015.

In terms of facilities, 247 acres of swimming beach, 92,500 acres of boating water, 5,000 camping units, and 4,600 picnic tables will ultimately be required in 2015 (see Chart 7 and supporting data in Part IX).

CHART 7

BIG BLACK RIVER BASIN
EXISTING AND PROJECTED AVERAGE SUMMER SUNDAY UNSATISFIED DEMAND AND NEEDS
(EXPRESSED IN TERMS OF FACILITIES)

	Swimming Capacity	Boating Capacity	Canoeing Capacity	Camping Capacity	Picnicking Capacity
1965 Average Summer Sunday Demand	30,407	9,424	489	5,112	10,047
1965 Average Summer Sunday Supply[1]	7,965	2,491	4,370	1,001	4,130
1965 Needs	22,442	6,933		4,111	5,917
1965 Need in Facilities	37.4 acres	13,866 acres		822 units	592 tables
1980 Average Summer Sunday Demand	48,634	15,074	782	8,177	16,069
1970 Average Summer Sunday Supply[1]	9,165	2,510	4,370	1,517	5,380
1980 Needs	39,469	12,564		6,660	10,689
1980 Need in Facilities	65.8 acres	25,128 acres		1,332 units	1,069 tables
2015 Average Summer Sunday Demand	157,336	48,765	2,530	26,453	51,985
1970 Average Summer Sunday Supply[1]	9,165	2,510	4,370	1,517	5,380
2015 Needs	148,171	46,255		24,936	46,605
2015 Need in Facilities	247 acres	92,510 acres		4,987 units	4,660 tables

1. Supply includes both public and private supply.

PART IV - OUTDOOR RECREATION PLAN

APPRAISAL OF RECREATION POTENTIAL

The most critical recreation need in the basin is that for boating water. Approximately 26 percent of the existing demand for boating water is presently being satisfied. This figure decreases to 17 percent and 5 percent of the projected demand in 1980 and 2015, respectively. Swimming areas are also in short supply in the basin and now satisfy only 26 percent of this demand. Considering presently programmed facilities, 81 percent of the projected demand for 1980 and 94 percent of the demand for 2015 will remain unsatisfied.

The present supply of camping facilities is meeting 20 percent of the existing demand. Even with the additional facilities presently programmed, only 13 percent of the projected demand will be satisfied in 1980 and 6 percent in 2015. Additional picnic areas and facilities are needed now and the need for them becomes much greater in the two target years. Presently, 41 percent of the existing demand is being met, but known programmed facilities for the basin will meet only 33 percent of the projected demand in 1980 and 10 percent in 2015.

To meet the existing and growing demand for outdoor recreation in the basin, several Federal agencies have prepared proposals. These proposals include expansion of existing resources and facilities and development of new outdoor recreation areas. The resource in shortest supply in the basin is water suitable for boating and swimming.

Many good potential reservoir sites exist in the basin, particularly in that portion north of U.S. Highway 80. Because the basin is still predominately a farming area, good bottomland hardwood habitat provides ample hunting areas. Pollution is a problem in parts of the basin.

The increasing demand for water-enhanced recreation activities, principally, camping and picnicking, can be met in part at sites surrounding the future water impoundments in the basin and by expanding existing facilities of the Mississippi Park System and the U.S. Forest Service at two areas in the study area.

Some of the demand for camping and picnicking can be met by improving access to the Big Black River and its larger tributaries and by providing some facilities at such sites. State and local groups have the capabilities to support programs of this nature. The Mississippi River also could help meet some of this demand through improved access.

The portion of Mississippi's 16th section lands in the basin which is forest land has been included in the supply inventory in this report. These lands are under the jurisdiction of the various County Boards of Supervisors and represent a potential resource for the basin.

In addition to the future development of public facilities, the private sector is also expected to increase its share of the recreation supply through development of farm ponds and lakes by landowners to provide facilities for family recreation needs. In 1965, the private sector accounted for about 38 percent of the supply (public and private) for the activities of swimming, boating, camping, and picnicking. When the 1965 private supply for the four major activities is compared to the total daily supply for these activities in 1970, the daily private supply still represents about 32 percent of the total daily supply.

In Mississippi, the private sector should, therefore, be capable of meeting much of the remaining unsatisifed demand in 1980 and 2015. A recent inventory by the Soil Conservation Service in Mississippi, to obtain information on the incidental recreation use of flood prevention reservoirs, showed that private lakes are used for fishing, boating, swimming, picnicking, camping, and hiking. Fishing accounted for a large part of the overall recreation use.

In the early-action period, the U.S. Department of Agriculture has proposed construction of over 200 single-purpose floodwater retarding reservoirs throughout the basin. These reservoirs, many of which will be in excess of 50 and some over 100 surface acres, will total 8,000 surface acres of water. With the inability of the supply to meet the demand, it is expected that landowners will continue the trend of using these single-purpose reservoirs for certain recreation activities. These reservoirs are capable of meeting many family needs for recreation.

The Natchez Trace Parkway is considered in the development of the recreation plan. A large part of the Trace in the study area is already completed and open for use. The only uncompleted portions are in the vicinity of Jackson, in Hinds and southern Madison Counties, and a short portion in extreme southern Claiborne County. Two parks are developed and offer camping and picnic facilities. In addition, several picnic areas are located along the route for use by visitors. Historic areas have been marked and excellent interpretative facilities are provided at some of these areas. In other areas, portions of the old Trace have been preserved and visitors are afforded walking opportunities. Overall, this development by the National Park Service presently provides, and will continue to provide, outdoor recreationists the opportunity to participate in the popular activities of driving for pleasure, walking for pleasure, hiking, nature study, picnicking, camping, and the study of the early history of our Nation.

The Vicksburg National Military Park, a historical attraction, is experiencing an increase in visitors each year. However, appropriate development would conform to its primary purpose for existence.

ESTABLISHMENT OF GOALS

The goal of this plan is to satisfy the recreation desires of the population within the market area of the Big Black River Basin to the extent practical, as revealed by the appraisal of the area's recreation resource potential.

A variety of recreational needs will be satisfied by the plan, but this must be done with an emphasis toward protecting natural resources and utilization of these resources in a complementary manner.

ALTERNATIVES

In studying the recreation demand, supply and needs and the best way of meeting these needs, consideration was given to the possible development of other nearby river basins as a means of satisfying some of the recreational demands of the Big Black River Basin Recreation Market Area. The Pearl River Comprehensive Basin Plan indicates that recreation demand generated from that study area will be difficult to satisfy. Except for the proposed Yazoo River navigation project previously discussed, no plans have been made to include recreational services located immediately outside the basin in this recreation market area.

The Corps of Engineers considered a group of 17 tributary multiple-purpose reservoirs. Their recreation potential and ability to satisfy the recreation demand of the basin was evaluated. Details of the evaluation of these potential reservoirs appear in the Corps of Engineers report (Volume III, Annex B). Although these multiple-purpose projects were not feasible in the final analysis, several offered excellent recreation potentials.

The upstream watershed program of the U.S. Department of Agriculture considered and ultimately included 17 multiple-purpose reservoirs in the 10-15 year plan and six multiple-purpose upstream watershed reservoirs in the long-range plan.

Expansion of existing recreation areas and the development of new recreation areas on public lands were considered as an alternative. These areas are the Holmes County State Park, the Choctaw Recreation Area, and the Tombigbee National Forest.

FEATURES OF THE PLAN

The 10-15 year recreation plan consists of development of the proposed U.S. Department of Agriculture multiple-purpose upstream watershed reservoirs for recreation and single-purpose projects necessary to satisfy additional recreation demand. In the long-range (2015) period, more upstream watershed reservoirs and single-purpose reservoir projects are considered together with recreation facility expansion at the 10-15 year projects (see Chart 8).

Early-Action Plan

The largest segment of the early-action plan is the development of recreation facilities at 17 upstream watershed reservoirs. Ten of these reservoirs would be developed for general recreation activities and seven would have facilities for boating activities only. Development of facilities at these 17 reservoirs will accommodate 1.1 million activity occasions annually.

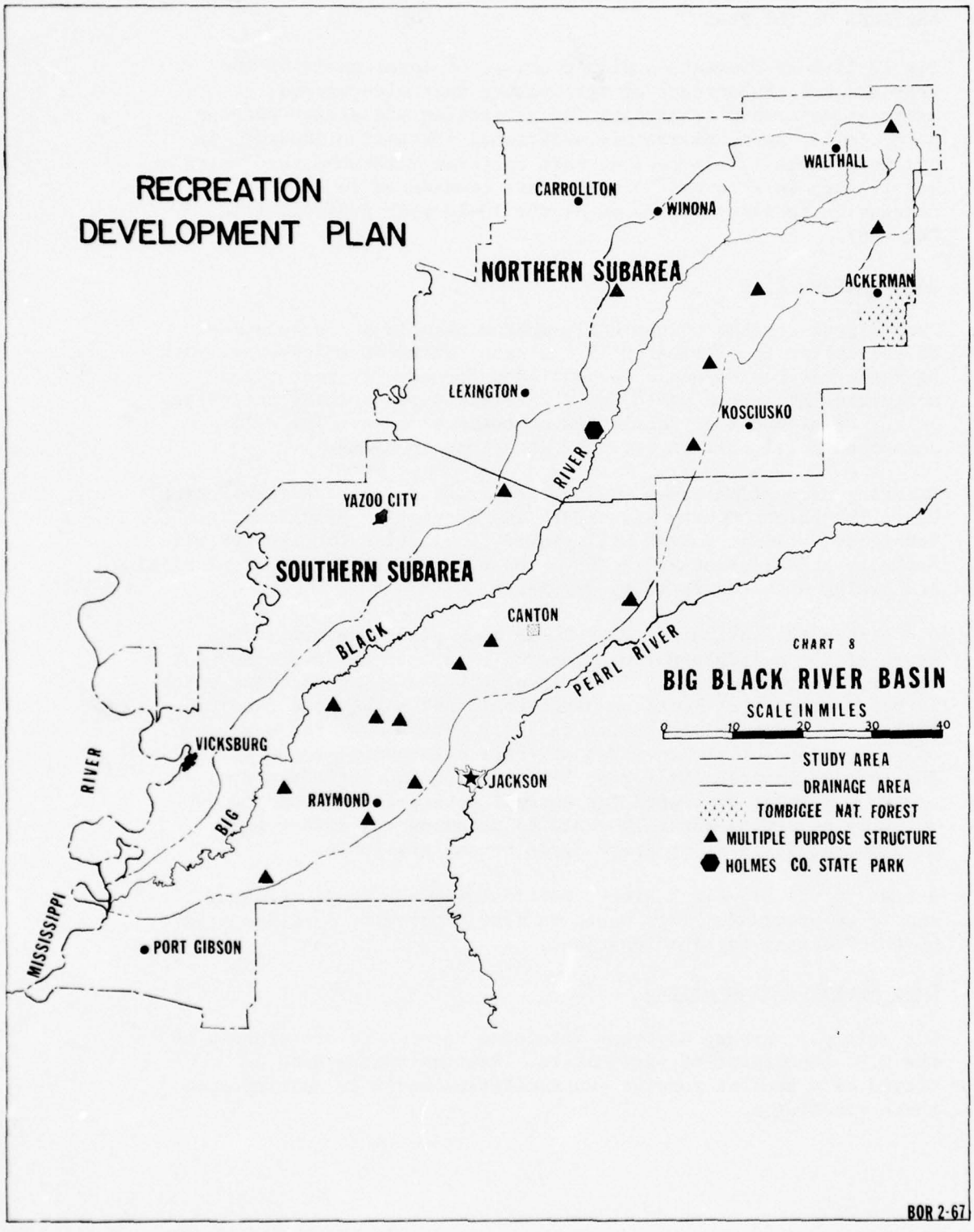
Existing recreation areas would be expanded to support more recreation use. The Holmes County State Park and recreation areas in the Tombigbee National Forest will provide facilities for 170,000 more activity occasions annually for swimming, camping, boating, picnicking, and hiking with the facility expansion.

One option is available in the 10-15 year plan. As mentioned, seven of the multiple-purpose reservoirs are to be developed with boating facilities only. This was done because more boating water is badly needed but local sponsors could not supply the funds necessary to support intensive facility development for a variety of recreation activities. Two of these reservoirs--Bogue Chitto (No. 8) and Fourteen Mile (No. 2)--totaling 800 surface acres, could be further developed for general recreation. Over 350,000 activity occasions annually could be accommodated with further development if local or State funds become available.

Access to the Big Black River, particularly the lower reaches, should be provided. This would be done after more detailed studies by the State as to site locations.

Long-Range Considerations

Six multiple purpose upstream watershed reservoirs are planned by the U.S. Department of Agriculture. Recreation has been included as a project purpose and facilities could be developed on these reservoirs.


RECREATION
DEVELOPMENT PLAN
NORTHERN SUBAREA
SOUTHERN SUBAREA
CARROLLTON
WINONA
WALTHALL
ACKERMAN
LEXINGTON
KOSCIUSKO
YAZOO CITY
CANTON
VICKSBURG
RAYMOND
JACKSON
PORT GIBSON
BLACK RIVER
BIG BLACK RIVER
PEARL RIVER
MISSISSIPPI RIVER
CHART 8
BIG BLACK RIVER BASIN
SCALE IN MILES
0 10 20 30 40
STUDY AREA
DRAINAGE AREA
TOMBIGEE NAT. FOREST
MULTIPLE PURPOSE STRUCTURE
HOLMES CO. STATE PARK
BOR 2-67

Facilities on the seventeen 10-15 year multiple-purpose projects can be expanded to provide for more recreation use. This expansion and new facility development could accommodate a use of 4.2 million activity occasions annually.

Single-purpose projects can provide more recreation opportunities. In the northern subarea, single-purpose recreation reservoirs on Zilpha, Mulberry, and Seneatcha Creeks would provide 3,000 acres of additional water if constructed and favorable conditions exist for the development of recreation facilities. The Holmes County State Park and recreation areas in the Tombigbee National Forest can be further expanded to provide more facilities.

In the southern subarea for the 2015 period, added recreational facilities are badly needed In addition to the expanded recreation development at the 10-15 year plan reservoirs proposed by the U.S. Department of Agriculture, a 10,000-acre reservoir should be considered for construction on the Big Black River near Edwards. Development of this resource for recreation could initially accommodate over 3 million activity occasions annually. Single-purpose estimates for long-range plan development would provide facilities to accommodate a use of about 5 million annual activity occasions.

Discussion

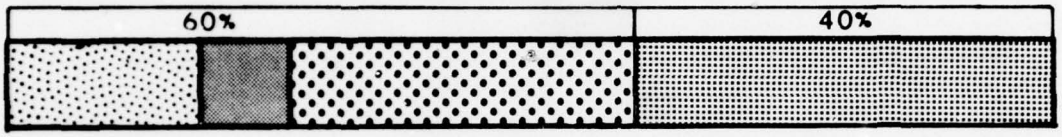
The facilities planned for the outdoor recreation developments include 35 miles of trails in the 10-15 year projects and 71 miles of trails in the long-range projects. These trails will accommodate people who wish to hike, study nature, or walk for pleasure as part of their outdoor recreation experiences.

By implementing the recreation plan, about 58 percent of the 1980 average summer Sunday demand for the four major activities will be satisfied. The 10-15 year plan provides facilities for these activities that will accommodate more than 1 million recreation days annually (see Chart 9).

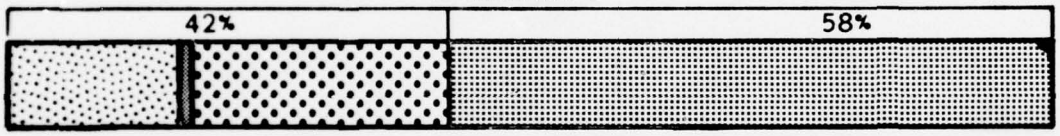
With the considered long-range plan, about 51 percent of the projected average summer Sunday demand for the four major activities would be satisfied. The plan suggests facilities that will accommodate a use of more than 3 million recreation days annually in 2015. The present pattern of recreation use appears likely to continue for the next few years (see Chart 10).

CHART 9
PERCENT OF AVERAGE SUMMER SUNDAY DEMAND SATISFIED WITH PROPOSED PLAN 1980

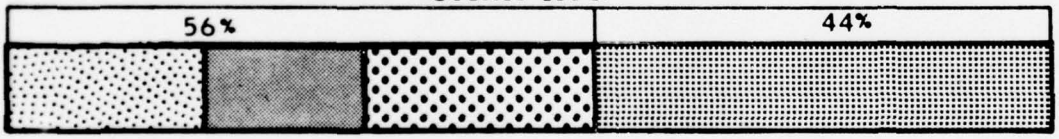
SWIMMING



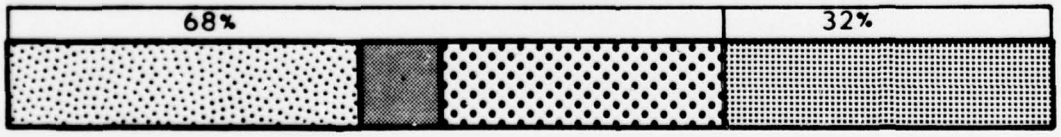
BOATING



CAMPING



PICNICKING

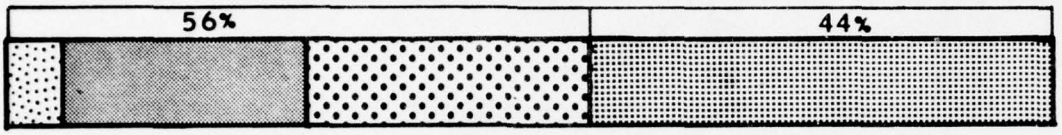


Legend:

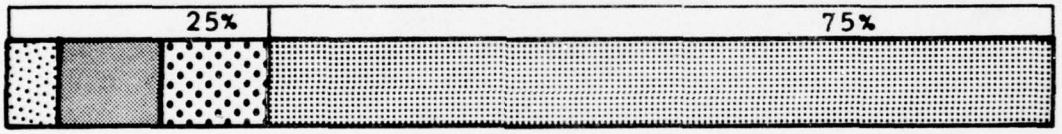
- Existing Supply (1970)
- Single Purpose Projects
- Multi-Purpose Projects
- Unsatisfied Demand

CHART 10
PERCENT OF AVERAGE SUMMER SUNDAY DEMAND SATISFIED WITH PROPOSED PLAN
2015

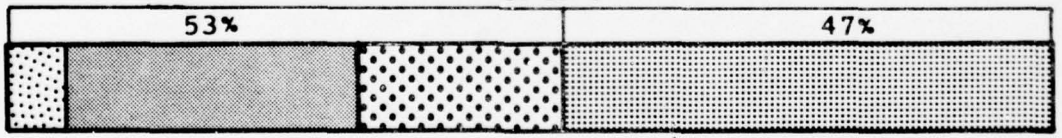
SWIMMING



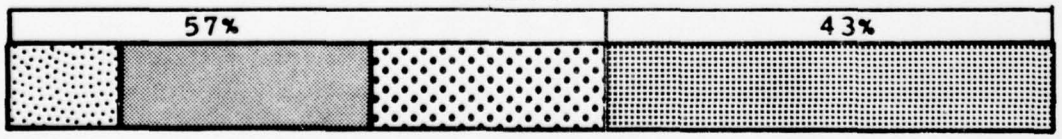
BOATING



CAMPING



PICNICKING



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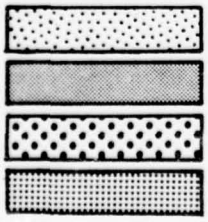


Existing Supply (1970)
Single Purpose Projects
Multi-Purpose Projects
Unsatisfied Demand

SUGGESTED ADMINISTRATIVE AND FUNDING ARRANGEMENTS

The administration and funding of the recreation developments for the Big Black River Basin can be handled through several methods depending on the construction agency and the various policies involved. Administrative and funding cost-sharing arrangements possible under present laws and policies are shown in Chart 11. Cost-sharing and funding should follow the procedures outlined in this chart. The principal agencies for administration and cost-charing are the "local organizations" as defined in the Watershed Protection and Flood Prevention Act, Public Law 566, and various State agencies.

The emphasis on non-Federal or local cost charing of funding with assistance from the Federal Government where permissible is in keeping with current policies and legislation of the Congress. Federal assistance can be obtained through such legislation and programs as the Watershed Protection and Flood Prevention Act (Public Law 566), the Land and Water Conservation Fund Act (Public Law 88-578), the Housing and Urban Development Act (Public Law 89-117), the Federal Aid in Fish Restoration Act of 1953 (64 Stat. 430), and the Federal Aid in Wildlife Restoration Act of 1937 (50 Stat. 917).

CHART 11

BIG BLACK RIVER BASIN
POSSIBLE ADMINISTRATIVE AND FUNDING ARRANGEMENTS OF RECREATION
AREAS UNDER PRESENT LAWS AND REGULATIONS

Construction Agency	Recreation Areas to be Administered by:	Cost Sharing or Funding of Recreation Development by:
Local organizations (sponsors) under Public Law 566 with asaistance from the Soil Conservation Service	Administration of recreation areas at public recreational developments by "local organizations"[1] according to Section 4 of the Watershed Protection and Flood Prevention Act as amended Sept. 27, 1962.	Recreation area development costs and modifications of the project for recreation will be shared by "local organizations"[1] and the Soil Conservation Service according to section 4 of P.L. 566. Some development may be funded by the Land and Water Conservation Fund Act.
	Privately owned and operated recreation areas administered by landowners.	Recreation area development funded by landowners.
	Administration by U.S. Forest Service when area lies on National Forest land.	Recreation area development costs funded by U.S. Forest Service.
Big Black Waterway District	Administration of recreation areas by the Big Black Waterway District or by State of local agencies.	Funding by State or local agencies with cost sharing under provision of Land and Water Conservation Fund Act of 1965.
		Funding by Big Black Waterway District with cost sharing under provisions of Land and Water Conservation Fund Act of 1965.
	Administration of recreation areas by the U.S. Forest Service on National Forest land.	Recreation area development funded by the U.S. Forest Service.
U.S. Forest Service	Administration of recreation areas by the U.S. Forest Service on National Forest land.	Recreation area development funded by U.S. Forest Service.
		Land acquisition may be financed by the Land and Water Conservation Fund Act of 1965 (P.L. 88-578) and the Weeks Law of 1911.
State of Mississippi	Mississippi Park System	Funding by Mississippi Park System with cost sharing under provisions of the Land and Water Conservation Fund Act of 1965, and and Housing and Development Act of 1965.
	Mississippi Game and Fish Commission.	Funding for fishing areas could be under provisions of the Dingell-Johnson Act. Funding for hunting areas could be under provisions of the Pittman-Robertson Act. State funds may also be used for both types of areas.
Local governmental bodies	The Administration by local Governmental bodies.	Funding by local Governmental bodies with cost sharing under provisions of the Land and Water Conservation Fund Act of 1965, and the Housing and Development Act of 1965.

1. Any State, political subdivision thereof, soil or water conservation district, flood prevention or control district, or combinations thereof, or any other agency having authority under State law to carry out, maintain and operate the works of improvement; or any irrigation or reservoir company, water users' association, or similar organization having such authority and not being operated for profit.

PART V - EVALUATION

BENEFITS

Tangible Benefits

Annual benefits that will accrue from the 10-15 year recreation plan are $950,000. This estimate is based on outdoor recreation development to accommodate 750,000 recreation days annually. Benefits were estimated by determining the value of a recreation day at each project. The value was based on location of the project with respect to population concentrations, alternative recreation areas and facilities to be provided at the project. Recreation day values ranged from $1 to $1.25. Chart 12 summarizes the estimated recreation benefits derived from each water resource improvement.

Intangible Benefits

Other investments might well achieve monetary returns comparable with or in excess of those expected from investments proposed in this recreation plan. It is in the realm of intangible benefits that investments in recreation often obtain more merit.

Many types of recreation opportunities will be available at the proposed recreation areas allowing recreators, to satisfy a wide range of outdoor desires and interests without utilizing excessive time or space which, in the future, are likely to be critical resources. The wide range of recreation experiences that will be available at the proposed projects may also result in the users achieving a more complete understanding of the natural world in which they live.

In addition, the proposed bodies of water may be considered as offering an aesthetic experience having intangible value. Some studies have indicated that in an urban area mental and physical health can be improved by providing additional recreation facilities.

Although the majority of the visitors to the proposed recreation areas will receive intangible benefits, it does not appear that the project cost will be significantly altered in order to provide them. The nature of the intangible benefits described suggests that no change in types of investments would be needed and therefore, there would be no alteration in net benefits from other project purposes in order to accommodate the intangible recreation benefits.

CHART 12

BIG BLACK RIVER BASIN
ESTIMATED RECREATION BENEFITS
FROM PROPOSED EARLY-ACTION PROJECTS
(1980)

Projects	Estimated Annual Recreation Activity Occasions	Annual Activity Occasions Converted to Recreation Days	Estimated Value of Recreation Days	Annual Recreation Benefits	Estimated Annual Reservoir Fishing in Man-Days of Use[1]	Estimated Increased Man-Days of Waterfowl Hunting[2]	Total Annual Recreation Benefits
U.S. Dept. of Agriculture							
Fourteen Mile (No. 7)	113,389	49,300	$ 1.25	61,625	1,000		$ 62,625
Fourteen Mile (No. 2)	9,750	9,750	1.00	9,750	2,000		10,750
Bakers Creek (No. 1)	145,465	63,246	1.25	79,057	1,000		80,057
Bakers Creek (No. 5)	7,345	7,345	1.00	7,345	1,000		9,345
Doaks Creek	118,725	51,620	1.25	64,525	1,000		65,525
Big Cypress	118,725	51,620	1.25	64,525	1,000		65,525
Panther-Hanging Moss	16,250	16,250	1.00	16,250	3,000		19,250
Porter Cox	9,750	9,750	1.00	9,750	2,000		11,750
Bogue Chitto (No. 8)	16,250	16,250	1.00	16,250	3,000		19,250
Bogue Chitto (No. 3)	8,125	8,125	1.00	8,125	1,000		9,125
Five Mile Creek	5,720	5,720	1.00	5,720	1,000		6,720
Long Creek	83,997	36,520	1.25	45,312	3,000		48,312
Peachahala Creek	86,649	37,673	1.25	47,091	2,000		49,091
Poplar Creek	102,465	44,550	1.25	55,687	3,000		58,687
Big Bywy Creek	100,265	43,593	1.25	54,491	3,000		57,491
Spring Creek	102,465	44,550	1.25	55,687	3,000		58,687
Apookta Creek	73,480	31,968	1.25	39,935	2,000		41,935
Subtotal	1,118,845	527,810	-	641,155	33,000	400	675,325
Single-Purpose Projects							
Tombigbee National Forest	109,582	47,644	1.25	59,555	-	-	59,555
Holmes County State Park	57,913	25,180	1.25	31,475	-	-	31,475
Bogue Chitto (No. 8)[3]	266,530	98,491	1.25	123,114	-	-	123,114
Fourteen Mile (No. 2)[3]	124,097	53,955	1.25	67,444	-	-	67,444
Subtotal	518,122	225,270	-	281,588			281,588
Total	1,636,967	753,080	-	922,743	33,000	400	956,913

1. Reservoir fishing is valued at $1.00 per man-day.

2. Waterfowl hunting is valued at $3.00 per man-day.

3. Benefits from optional development.

COST

Cost of the 17 multiple-purpose structures proposed in the early-action recreation plan is $6 million. The cost of these projects allotted to recreation, including recreation facilities to be constructed, is $3 million. The cost of the two single-purpose projects in the 10-15 year plan is approximately $600,000. Chart 13 summarizes the cost to provide for the recreation development at each water resource improvement.

Additional information on costs is given in the Interagency Summary Report (Volume I) and in the U.S. Department of Agriculture's report (Volume II, Annex A).

Some of the needs of the recreation market area for facilities for swimming, picnicking, camping, and hiking could be met through the expansion of existing recreation areas and the construction of new areas. The cost of providing these extra facilities would be approximately the same as the proposed early-action multiple-purpose reservoirs. However, in the case of water-dependent recreation activities, there is a shortage of water acreage in the basin which would necessitate the construction of reservoirs to meet the unsatisfied demand for boating and swimming. This could be done through the construction of single-purpose recreation reservoirs. The estimated costs for these alternatives are shown on Chart 14.

CHART 13

BIG BLACK RIVER BASIN
ESTIMATED RECREATION COSTS OF
PROPOSED EARLY ACTION PROJECTS (1980)

Projects	Total Installation Costs	Installation Costs Allocated to Recreation	Construction and Installation Services	Land Costs	Other Costs	Total Cost of Recreation Facilities	Total Costs Multi-Purpose Structure & Basic Recreation Facilities	Annual Operation and Maintenance Cost	Total Annual Costs for Recreation
U.S. Department of Agriculture									
Fourteen Mile Creek (No. 7)	200,896	125,151	215,417	13,375	1,984	230,776	355,927	18,800	30,065
Fourteen Mile Creek (No. 2)	280,789	126,194[1]	-	-	-	-	-	2,555	6,549
Bakers Creek (No. 1)	238,016	105,261	250,166	16,625	2,223	269,014	374,275	21,768	33,614
Bakers Creek (No. 5)	200,477	94,621[1]	-	-	-	-	-	1,975	4,970
Doaks Creek	206,934	110,844	193,321	16,625	1,831	211,777	322,621	17,232	27,443
Big Cypress	222,994	103,162	193,321	16,625	1,831	211,777	314,939	17,184	27,152
Panther-Hanging Moss	371,247	161,379[1]	-	-	-	-	-	3,636	8,744
Porter-Cox	258,171	117,360[1]	-	-	-	-	-	2,304	6,019
Bogue Chitto (No. 8)	428,623	155,073[1]	-	-	-	-	-	3,611	8,938
Bogue Chitto (No. 3)	248,119	77,511[1]	-	-	-	-	-	2,036	4,071
Five Mile Creek	168,960	83,307[1]	-	-	-	-	-	1,710	4,347
Long Creek[2]	216,721	75,434	29,185	8,400	701	38,286	113,720	5,690	9,415
Peachahala Creek	187,662	118,693	158,414	13,375	1,591	173,380	292,073	14,194	23,438
Poplar Creek	225,478	143,036	169,407	16,625	1,667	187,699	330,735	15,330	25,798
Big Bywy Creek	221,459	152,672	164,546	16,625	1,633	182,804	335,476	14,987	25,605
Spring Creek	240,576	135,897	169,407	16,625	1,667	187,699	323,596	15,326	25,568
Apookta Creek[3]	150,058	107,418	133,684	10,000	1,421	145,105	252,523	11,938	19,930
U.S. Department of Agriculture Total	4,067,180	1,993,013	1,676,868	144,900	16,549	1,838,317	3,015,885	170,276	291,666
Single Purpose Projects									
Tombigbee National Forest	-	-	-	-	-	241,600	241,600	-	-
Holmes County State Park	-	-	-	-	-	186,400	186,400	-	-
Bogue Chitto (No. 8)[4]	-	-	104,450	15,000	-	119,450	119,450	-	-
Fourteen Mile (No. 2)[4]	-	-	58,000	8,000	-	66,000	66,000	-	-
Single-Purpose Projects Total			162,450	23,000		613,450	613,450		

1. Includes cost of boating facilities proposed for these reservoirs by the U.S. Department of Agriculture.

2. Presently authorized under Public Law 566.

3. Proposed for authorization under Public Law 566.

4. Cost of optional development.

CHART 14

BIG BLACK RIVER BASIN
COST OF SINGLE-PURPOSE ALTERNATIVES
TO THE 10 - 15 YEAR RECREATION PLAN

Project	Estimated Cost of Structure, Reservoir Lands, and Relocations	Estimated Cost of Recreation Lands and Facilities	Contingency (20%)	Engineering and Design Costs (10%)	Supervision and Administration Costs (8%)	Total First Cost
Poplar Creek Reservoir	$ 1,064,200	$ 215,900	$ 256,000	$ 153,600	$ 135,200	$ 1,824,900
Zilpha Creek Reservoir	1,640,100	351,500	398,000	239,000	211,000	2,839,600
Seneatcha Creek Reservoir	1,558,900	105,500	332,900	199,700	175,800	2,372,800
Apookta Creek Reservoir	775,500	58,800	166,900	100,100	88,100	1,189,400
Mulberry Creek Reservoir	515,600	257,100	154,500	92,700	88,600	1,108,500
Choctaw Recreation Area	-	203,400	-	20,300	17,900	241,600
Holmes County State Park	-	156,900	-	15,700	13,800	186,400
Big Black River Reservoir	10,990,000	2,520,000	2,700,000	1,370,000	1,220,000	18,800,000
Total	16,544,300	3,869,100	4,008,300	2,191,100	1,950,400	28,563,200

PART VI - COORDINATION WITH OTHER INTERESTS

The preparation of this report has been coordinated with interested Federal and non-Federal agencies. Interagency work level meerings held as needed, were attended by representatives of the Corps of Engineers, Soil Conservation Service, Economic Research Service, U.S. Forest Service, Bureau of Sport Fisheries and Wildlife, and the Mississippi Park System.

Coordination with the State of Mississippi was conducted primarily through the Mississippi Park System and the Mississippi Game and Fish Commission. The Mississippi Forest Service also furnished data used in this report.

The Bureau of Sport Fisheries and Wildlife prepared a report (Volume II, Annex D) on the fish and wildlife aspects of the Big Black River Basin. Information from their report has been used in preparing this report.

PART VII - CONCLUSIONS

As a result of this study, the following conclusions are drawn:

1. The total annual demand in activity occasions was 16 million in 1965 and is expected to increase to 82 million by 2015. For the four major activities of swimming, boating, camping, and picnicking the demand in 1965 was 1.8 million activity occasions and by 2015, 10.5 million activity occasions.

2. The demand is greatest in the southern part of the basin because this area has the greatest present population and projected growth and is influenced by the Jackson SMSA.

3. Presently, 850,000 activity occasions annually can be accommodated for boating, swimming, camping, and picnicking. This supply will be 1 million activity occasions by 1970 considering programmed expansion of existing recreation areas.

4. The potential Yazoo Navigation Project, adjacent to the Big Black River Basin, can supply outdoor recreation opportunities through construction of a navigation pool and modification of the operation of three existing reservoirs.

5. The supply of outdoor recreation resources and facilities falls far short of meeting the existing demand for such facilities. In the projected years of 1980 and 2015, the imbalance between supply and demand becomes much greater. The southern subarea is the area of greatest need due to this area having the majority of the basin's present population and most of the basin's projected growth.

6. The greatest projected recreation need in the basin is for water areas to satisfy the demand for boating and swimming. While some of the unsatisfied demand for these activities can be met by the private sector and by better access to major streams, such projects would satisfy only a small part of the basin's unsatisfied demand. Public projects are necessary to provide additional recreation opportunities.

7. The physiographic features of the northern subarea make this area more conducive to reservoir and adjacent recreation area development.

8. The 16th section lands offer possibilities for development of hunting areas or for possible expansion of existing recreation areas.

9. A large part of the unsatisfied demand presently and in 1980 can be met by the construction of multiple-purpose water impoundments, the expansion of existing recreation areas, and the development of new recreation areas.

10. The private sector can provide needed recreation facilities by developing private lakes for family recreation use.

11. Existing pollution problems in the basin can be effectively improved through coordinated local, State, and Federal action and acceptable water quality maintained.

12. Land-use management programs should be pursued in conjunction with recreation area development and expansion to promote protection and enhancement of recreation resources.

13. The scale of recreation development presented in this report requires local, State, and Federal agencies to coordinate all planning and development activities. This coordination should be directed by the State outdoor recreation planning staff utilizing the State Comprehensive Outdoor Recreation Plan as a focal point for all planning and development activities.

14. The State should review State laws pertaining to recreation area development periodically to determine if changes would further promote proper recreation development in the basin.

15. The net effect of this recreation plan on fish and wildlife will be favorable. The supply of fishing waters will be increased. Although the man-days of upland game hunting possible in the basin will diminish due to the reduction in the acreage of bottomland hardwood habitat, this loss will be somewhat offset with an increase in the man-days of waterfowl hunting provided by the proposed reservoirs.

PART VIII - RECOMMENDATIONS

Considering the findings and conclusions of this study, it is recommended that:

1. The following multiple-purpose reservoirs in the 10 - 15 year plan be constructed with recreation as a project purpose and be developed for recreation use as outlined in the plan:

   a. Fourteen Mile No. 7
   b. Fourteen Mile No. 2
   c. Bakers Creek No. 1
   d. Bakers Creek No. 5
   e. Bogue Chitto No. 8
   f. Bogue Chitto No. 3
   g. Doaks Creek
   h. Big Cypress
   i. Panther-Hanging Moss
   j. Porter Cox
   k. Five Mile Creek
   l. Long Creek
   m. Peachahala Creek
   n. Poplar Creek
   o. Big Bywy Creek
   p. Spring Creek
   q. Apookta Creek

2. The optional development outlined for Bogue Chitto No. 8 and Fourteen Mile No. 2 multiple-purpose reservoirs be implemented at the time local sponsors can furnish the necessary cost sharing.

3. Recreation facilities at the Holmes County State Park be expanded to the degree outlined in the plan.

4. Recreation area and facility expansion in the Tombigbee National Forest be implemented as outlined in the plan.

5. Access to the Big Black River, particularly the lower reaches, be developed by the State.

6. Water quality acceptable for primary water contact sports be maintained at all proposed recreation areas.

7. The Natchez Trace Parkway be completed as presently planned through the study area.

8. Land acquisition for recreation developments at public projects include sufficient land to allow for long-range expansion.

9. Recreation be studied as a project purpose in all future project formulations.

10. A continuing program of coordination be maintained between all Federal, State, and local outdoor recreation agencies to assure that all recreational development is in accord with and conforms to the Statewide Comprehensive Outdoor Recreation Plan.

PART IX - SUPPORTING DATA

METHODOLOGY

Recreation Market Area

For the purposes of this report, the recreation market area has been defined as the area from which 100 percent of the users are drawn on 1-day outings, weekend (overnight) trips, or both. Because of competing recreational opportunities outside of the basin available to the residents of the Jackson SMSA, the Interagency Recreation Work Group agreed that only 30 percent of the population from this SMSA will be counted as recreating in the Big Black River Basin. This percent figure is based on the distance of the Jackson SMSA from the outdoor recreation facilities available in the basin in comparison to other basins. It is also, in part, a mechanical calculation based on the percentage of the basin lying within a 125-mile radius of Jackson in comparison with the percentage of other basins (such as the Pearl and the Pascagoula) also lying within a 125-mile radius of Jackson.

Demand

Recreation demand is defined as a measurement of the amount and kinds of outdoor recreation facilities and activities the public desires. True demand tends to lie somewhere between what people desire and what they are actually willing to accept, probably nearer the latter. Demand then, is an expression of people's desires for outdoor recreation; supply is an appraisal of the capacity of the existing facilities to meet the demand; and need is the amount of resources and facilities necessary to meet the unsatisfied demand.

During 1959-60, the Bureau of the Census conducted, under contract to the Outdoor Recreation Resources Review Commission (ORRRC), home and origin surveys across the United States to obtain a statistical sampling of participation and preferences in 24 outdoor recreation activities. The participation data presented in Study Report 19 of the ORRRC publications has been used for this study.

The Bureau of the Census conducted survey for the Bureau of Outdoor Recreation to supplement and update this original recreation study. However, the data was not available in time to incorporate it into the computation necessary for appraisal and analysis of resources.

Since outdoor recreation is viewed as having an economic value to the participant, in that each dollar spent on outdoor recreation activity is a dollar that cannot be spent for other commodities or services, we conclude that per capita recreation demand is closely related to per capita personal income. The participation data for the Census South Region is used as a basis in determining the activity participation in the Big Black River Basin study area.

The following is a description of the demand method and an example of its use:

> The base year per capita personal income is assumed to generate, in the Census Region, the ORRRC participation rates for the activities listed. The method then determines how much proportionately of these participation rates could be generated by $1,000. In this method, the total per capita personal income of theparticipating population of any area under study in any year must first be determined. The adjusted participation rates are then multiplied by the number of thousands of dollars of personal income of the participating population in the area under study. With this method, the adjusted participation rates become constants for any year anywhere in the Census Region.
>
> Example:
>
> $1,785 (Census South Per Capita Personal Income, 1960), generates 3.97 summer swimming activity occasions in the South.
>
> $1,000 therefore, generates 2.224 swimming activity occasions.
>
> If the total personal income of a county in a given year is $500 million, the swimming demand in that county will be 500,000 x 2.224, or 1,112,000 swimming activity occasions.

In order to determine demand, the Big Black River Basin study area was divided into two subareas. Demand has been computed for the basin as a whole and for each subarea to show areas of greatest needs. Subareas follow county lines, enabling calculation of subarea populations, both present and projected, by counties. The portion of the Jackson SMSA population considered to recreate in the basin (30 percent) was also apportioned with 40 percent of the considered Jackson SMSA population being apportioned to the northern subarea and 60 percent to the southern subarea. Chart 15 is a summary of demand for the basin.

CHART 15

BIG BLACK RIVER BASIN
EXISTING AND PROJECTED TOTAL SUMMER, TOTAL ANNUAL,
AND AVERAGE SUMMER SUNDAY DEMAND EXPRESSED IN ACTIVITY OCCASIONS

AREA	1965 Population (1,000's)	1965 Per Capita Personal Income	1965 Population x PCPI (1,000's)	1980 Population (1,000's)	1980 Per Capita Personal Income	1980 Population x PCPI (1,000's)	2015 Population (1,000's)	2015 Per Capita Personal Income	2015 Population x PCPI (1,000's)
Big Black River Basin	235.4	1,325	311,905	248.5	1,731	430,154	379.0	2,873	1,088,867
Jackson SMSA (30% participation)	64.7	2,050	132,635	100.6	2,792	280,875	241.5	5,016	1,211,364
Total (100%)	300.1		444,540	349.1		711,029	620.5		2,300,231

Activities and Activity Groups	Activity Occasions Per $1,000 Personal Income	1965 Total Summer Demand in Activity Occasions (1,000's)	1965 Total Annual Demand in Activity Occasions 1,000's)	1965 Average Summer Sunday Demand in Activity Occasions	1980 Total Summer Demand in Activity Occasions (1,000's)	1980 Total Annual Demand in Activity Occasions (1,000's)	1980 Average Summer Sunday Demand in Activity Occasions	2015 Total Summer Demand in Activity Occasions (1,000's)	2015 Total Annual Demand in Activity Occasions (1,000's)	2015 Average Summer Sunday Demand in Activity Occasions
Swimming	2.224	988.7	1,379.8	30,407	1,581.3	2,207.0	48,634	5,115.7	7,139.9	157,336
Boating, Water-skiing, Sailing	.689	306.3	607.7	9,424	489.9	972.0	15,074	1,584.9	3,144.4	48,765
Canoeing	.034	15.1	24.9	489	24.2	39.8	782	78.2	128.8	2,530
Subtotal (Water-Dependent)	2.947	1,310.1	2,012.4	40,320	2,095.4	3,218.8	64,490	6,778.8	10,413	208,631
Camping	.213	94.7	196.9	5,112	151.5	314.9	8,177	489.9	1,019.0	26,453
Picnicking	.734	326.3	689.9	10,047	521.9	1,103.5	16,069	1,688.4	3,570.0	51,985
Subtotal (Water-Enhanced)	.947	421.0	886.8	15,159	673.4	1,418.4	24,246	2,178.3	4,589.0	78,438
Other Activities	8.723	3,877.7	12,925.7	119,314	6,202.3	20,674.3	190,840	20,064.9	66,883.0	617,381
Grand Total	12.617	5,608.8	15,824.9	174,793	8,971.1	25,311.5	279,576	29,022.0	81,885.1	904,450

The average summer Sunday demand has been calculated on the basis of a 13-week summer period. By taking 40 percent of the average weekly figures, the amount of activity occurring on Sunday was obtained for all activities listed except camping. In the case of camping, 75 percent of the summer activity has been determined to occur on Saturday and Sunday.

Supply

Data on Existing Recreation Areas and Facilities in the Big Black River Basin study area are shown on Charts 16 and 17. This information was obtained from Nationwide Inventory Forms compiled by the Bureau of Outdoor Recreation.

The largest amount of public recreation land is found in the northern subarea, mostly in the Choctaw County portion of the Tombigbee National Forest and the Choctaw Wildlife Management Area. Only a small percentage of the public recreational land in both subareas includes much water for water-dependent and water-enhanced outdoor recreation activities.

Comparison of the percentage of Class I (High Density Outdoor Recreation Areas), Class II (General Outdoor Recreation Areas), and Class VI (Historic and Cultural Sites), with Class III (Natural Environment Areas) by subarea, gives what appears to be contrasting figures. However, large Class III areas are found mainly in the northern subarea, while the southern subarea includes the 1,339 acres of the historic Vicksburg National Military Park.

By excluding attendance at the Vicksburg National Military Park, the majority of the population recreating in the Big Black River Basin is doing so primarily in the Tombigbee National Forest. Although the northern subarea has roughly one-third of the population of the basin, the National Forest area, lying within and just outside of it, attracts people from the more heavily populated southern subarea.

The 16th section lands have been omitted from the graphic presentations. This land (that part classified as forest land) was included in the supply data primarily because it represents both a present and potential resource. As far as is known, none of this land is presently being used for recreation. The potential value of this land is discussed under APPRAISAL OF RECREATION POTENTIALS in Part IV of this report.

CHART 16

BIG BLACK RIVER BASIN
ACREAGES AND ATTENDANCES
FOR KNOWN PUBLIC RECREATION
AREAS - BY SUBAREA

Facility Name	Administrative Agency	County	Land Acres	Water Acres	Marsh Acres	Total	Classes I and II[1]	Class III[1]	Class IV[1]	Class V[1]	Class VI[1]	Acres of Developed Recreation Area	Reported Day Visits 1963	Reported Overnight Visits 1963
Choctaw Wildlife Mgt. Area	MG&FC[3]	Choctaw	5,787	-	-	5,787[2]	-	5,792	-	-	-	-	5,000	1,000
Choctaw Lake Recreation Area	USFS[4]	Choctaw	474	116	-	590	620	-	-	-	-	41	26,400	8,400
Tombigbee National Forest	USFS	Choctaw	10,739	-	-	10,739	-	10,588	-	-	-	-	142,000	-
Jeff Busby Park	NPS[5]	Choctaw	275	-	-	275	275	-	-	-	-	22	-	-
Holly Hill Picnic Area	NPS	Attala	5	-	-	5	5	-	-	-	-	5	-	-
Berea Church Picnic Area	NPS	Attala	2	-	-	2	2	-	-	-	-	2	-	-
Yowani Picnic Area	NPS	Choctaw	3	-	-	3	3	-	-	-	-	3	-	-
Ballard Creek Picnic Area	NPS	Choctaw	2	-	-	2	2	-	-	-	-	2	-	-
Holmes County State Park	MPS[6]	Holmes	510	60	-	570	570		-	-	-	113	35,000	950
Jason-Niles Park	City of Kosciusko	Attala	20	-	-	20	20	-	-	-	-	19	559	-
16th Section Lands (Forest Land)	MFS[7]	All	19,546	-	-	19,546	-	19,546	-	-	-	-	-	-
Northern Subarea Total			37,363	176	-	37,539	1,497	35,926	-	-	-	207	208,959	10,350
Vicksburg National Military Park	NPS	Warren	1,339	-	-	1,339	-	-	-	-	1,339	-	923,900	-
Rocky Springs Park	NPS	Claiborne	598	-	-	598	598	-	-	-	-	38	-	-
River Bend Picnic Area	NPS	Madison	14	-	-	14	14	-	-	-	-	14	-	-
Yockahockany Picnic Area	NPS	Madison	2	-	-	2	2	-	-	-	-	2	-	-
Grand Gulf State Park	MPS	Claiborne	104	-	-	104	-	-	-	-	104	1	20,000	-
Raymond Lake	MG&FC	Hinds	15	50	-	65	65	-	-	-	-	6	16,000	-
Vicksburg City Park	City of Vicksburg	Warren	66	-	-	66	62	-	-	-	4	9	-	-
Vicksburg Golf Course	City of Vicksburg	Warren	100	-	-	100	100	-	-	-	-	100	2,500	-
Saab Park	City of Canton	Madison	30	-	-	30	30	-	-	-	-	26	2,100	-
Brame Highland Park	City of Yazoo City	Yazoo	12	2	-	14	14	-	-	-	-	6	5,475	-
Camp Swagge Recreation Area	Camp Swagge Estate	Yazoo	75	-	2	77	77	-	-	-	-	7	-	-
16th Section Lands (Forest Lands)	MFS	All	26,943	-	-	26,943	-	26,943	-	-	-	-	-	-
Southern Subarea Total			29,298	52	2	29,352	962	26,943	-	-	1,447	209	969,975	-
Grand Total			66,661	228	2	66,891	2,459	62,869	-	-	1,447	416	1,178,934	10,350

1. Class I - High Density Recreation Area
   Class II - General Outdoor Recreation Area
   Class III - Natural Environment Area
   Class IV - Unique Natural Area
   Class V - Primitive Area
   Class VI - Historic and Cultural Sites

2. Acreage figures for the Choctaw Wildlife Management Area have been adjusted in consideration of the size of the Choctaw Lake Recreation Area and the Tombigbee National Forest, both of which lie within the Choctaw Wildlife Management Area. Actual size of the management area in Choctaw County is 17,000 acres.

3. Mississippi Game and Fish Commission

4. U.S. Forest Service

5. National Park Service

6. Mississippi Park System

7. Mississippi Forest Service

CHART 17

BIG BLACK RIVER BASIN
EXISTING AND PROJECTED TOTAL ANNUAL UNSATISFIED DEMAND
IN ACTIVITY OCCASIONS

	Swimming	Boating	Camping	Picnicking
1965 Total Annual Demand	1,379,800	607,700	196,900	689,900
1965 Total Annual Supply[1]	359,540	161,915	36,147	285,590
1965 Total Annual Unsatisfied Demand	1,020,260	445,785	160,753	404,310
1980 Total Annual Demand	2,207,000	972,000	314,900	1,103,500
1970 Total Annual Supply[1]	413,708	163,150	54,779	372,027
1980 Total Annual Unsatisfied Demand	1,793,292	808,850	260,121	731,473
2015 Total Annual Demand	7,139,900	3,144,400	1,019,000	3,570,000
1970 Total Annual Supply[1]	413,708	163,150	54,779	372,027
2015 Total Annual Unsatisfied Demand	6,726,192	2,981,250	964,221	3,197,973

1. Annual use that can be satisfied from supply.

Needs

Chart 7 shows the present and projected imbalance between demand and supply in terms of needs for the entire basin. Supply capacity figures have been given only until 1970 when the present programmed facilities, as reported on Nationwide Inventory Forms, will be in operation.

The demand has been shown in average summer Sunday demand. This method was selected for design purposes as it is the day, except for peak holidays such as the Fourth of July or Labor Day, when the greatest demand is put upon a river basin's supply facilities and is, therefore, the day which must be considered if the demand for the river basin's outdoor recreation opportunities is to be satisfied. The method used in making this conversion is the same as that used in making the conversions from facilities to capacity. Chart 17 gives the total annual needs in terms of activity occasions for the basin.

SUPPLEMENTARY INFORMATION AND TABLES

Chart 18 for the proposed early-action projects, and Chart 19 for the considered long-range (2015) projects show the additional recreation activities that can be accommodated at early-action projects in 2015 with an expansion of facilities.

The average summer Sunday capacity figures are considered the design load for each project. From them, an estimate of the annual activity occasions for each activity at each project was determined. These results are also shown in Charts 18 and 19.

An estimate of the tangible benefits that are expected to accrue with the implementation of the early-action recreation plan was made.

The expected number of activity occasions, from Chart 18, at each early-action project has been converted to recreation days in Chart 13 by dividing the total estimated activity occasions for each project proposed for full development by 2.3, assuming a recreation day includes 2.3 activities. On projects where recreation development for all activities was not proposed, a lesser factor was used depending on the number of recreation activities involved For example , on a project recommended for development of boating facilities only, the total estimated annual activity occasions were divided by 1 to obtain recreation days since only one recreation activity was considered.

In keeping with Supplement No. 1 of Senate Document No. 97, monetary unit values were assigned to a recreation day at each of the proposed projects.

An estimate of annual recreation benefits for each project was obtained by multiplying the annual recreation days expected to occur at each project by the monetary unit value given a recreation day at that project.

In addition to the annual recreation benefits, data was obtained from the Bureau of Sport Fisheries and wildlife regarding the estimated annual fishing and hunting man-days expected to occur at various projects. Monetary unit values were given to a man-day of each of the various fishing and hunting activities except upland game hunting. These values are found in the footnotes of Chart 12.

The values assigned to the various fishing and hunting activities have been multiplied by the relevant expected man-days of hunting or fishing and a total annual recreation benefit figure obtained for each project.

CHART 18

BIG BLACK RIVER BASIN
AVERAGE SUMMER SUNDAY CAPACITY AND ANNUAL USE IN
ACTIVITY OCCASIONS FOR PROPOSED EARLY ACTION PROJECTS

Early Action Projects (1980)	Normal Pool Size (Acres)	Boating		Swimming		Camping		Picnicking		Other Activities		Estimated Annual Recreation Activity Occasions
		Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	
U.S. Dept. of Agriculture[1]												
Fourteen Mile (No. 7)	200	100	6,500	900	40,500	140	5,040	223	15,400	410	45,949	113,389
Fourteen Mile (No. 2)	300	150	9,750	-	-	-	-	-	-	-	-	9,750
Bakers Creek (No. 1)	250	125	8,125	1,200	54,000	171	6,160	286	19,800	512	57,380	145,465
Bakers Creek (No. 5)	225	113	7,345	-	-	-	-	-	-	-	-	7,345
Doaks Creek	250	125	8,125	900	40,500	109	3,920	127	8,800	512	57,380	118,725
Big Cypress	250	125	8,125	900	40,500	109	3,920	127	8,800	512	57,380	118,725
Panther-Hanging Moss	500	250	16,250	-	-	-	-	-	-	-	-	16,250
Porter Cox	300	150	9,750	-	-	-	-	-	-	-	-	9,750
Bogue Chitto (No. 8)	500	250	16,250	-	-	-	-	-	-	-	-	16,250
Bogue Chitto (No. 3)	250	125	8,125	-	-	-	-	-	-	-	-	8,125
Five Mile Creek	175	88	5,720	-	-	-	-	-	-	-	-	5,720
Long Creek[2]	267	134	8,710	-	-	-	-	202	13,985	547	61,302	83,997
Peachahala Creek	200	100	6,500	600	27,000	78	2,800	64	4,400	410	45,949	86,649
Poplar Creek	250	125	8,125	600	27,000	93	3,360	95	6,600	512	57,380	102,465
Big Bywy Creek	250	125	8,125	600	27,000	93	3,360	64	4,400	512	57,380	100,265
Spring Creek	250	125	8,125	600	27,000	93	3,360	95	6,600	512	57,380	102,465
Apookta Creek[3]	150	75	4,875	600	27,000	78	2,800	64	4,400	307	34,405	73,480
Subtotal	4,567	2,285	148,525	6,900	310,500	964	34,720	1,347	93,185	4,746	531,885	1,118,845
Single-Purpose Projects												
Tombigbee National Forest	110	55	3,575	1,200	54,168	450	16,250	150	10,373	225	25,216	109,582
Holmes County State Park	-	-	-	600	27,084	375	13,541	250	17,288	-	-	57,913
Bogue Chitto (N. 8)[4]	-	-	-	1,540	69,515	200	7,222	505	34,921	1,025	114,872	226,530
Fourteen Mile (No. 2)[4]	-	-	-	600	27,000	200	7,222	303	20,952	612	68,923	124,097
Subtotal	110	55	3,575	3,940	177,767	1,225	44,235	1,208	83,534	1,865	209,011	518,122
Basin Total	4,677	2,340	152,100	10,840	488,267	2,189	78,955	2,555	176,719	6,211	740,896	1,636,967

1. Proposed for special basinwide authorization by U.S. Department of Agriculture.

2. Presently authorized under Public Law 566.

3. Proposed for authorization under Public Law 566.

4. Activity occasions that can be accommodated with further development described as an option.

CHART 19

BIG BLACK RIVER BASIN
AVERAGE SUMMER SUNDAY CAPACITY AND ANNUAL USE
IN ACTIVITY OCCASIONS FOR PROPOSED LONG-RANGE
PROJECTS AND ADDITIONAL USE AT EARLY ACTION PROJECTS

Long-Range Projects (2015)	Normal Pool Size (Acres)	Boating		Swimming		Camping		Picnicking		Other Activities		Estimated Annual Recreation Activity Occasions	Estimated Annual Recreation Days
		Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions	Average Summer Sunday Activity Occasions	Annual Activity Occasions		
U.S. Dept. of Agriculture													
Fourteen Mile (No. 7)	200	-	-	900	40,500	140	5,040	223	15,400	742	83,156	144,096	62,630
Fourteen Mile (No. 2)[1]	300	-	-	900	40,500	93	3,360	286	19,800	1,113	124,734	188,394	81,910
Bakers Creek (No. 1)	250	-	-	1,200	54,000	186	6,720	318	22,000	927	103,889	186,609	81 134
Bakers Creek (No. 5)	225	-	-	600	27,000	93	3,360	191	13,200	835	93,578	137,138	59,625
Doaks Creek	250	-	-	900	40,500	124	4,480	159	11,000	927	103,889	159,869	69,508
Big Cypress	250	-	-	900	40,500	124	4,480	159	11,000	927	103,889	159,869	69,508
Panther-Hanging Moss	500	-	-	1,500	67,500	186	6,720	477	33,000	1,855	207,890	315,110	137,004
Porter Cox	300	-	-	900	40,500	140	5,040	286	19,800	1,113	124,734	190,074	82,641
Bogue Chitto (No. 8)[1]	500	-	-	1,500	67,500	186	6,720	477	33,000	1,855	207,890	315,110	137,004
Bogue Chitto (No. 3)	250	-	-	600	27,000	93	3,360	223	15,400	927	103,889	149,649	65,065
Five Mile Creek	175	-	-	900	40,500	93	3,360	191	13,200	649	72,733	129,793	56,432
Long Creek	267	-	-	600	27,000	47	1,680	32	2,200	991	111,061	141,941	61,713
Peachahala Creek	200	-	-	600	27,000	78	2,800	64	4,400	742	83,156	117,356	51,024
Poplar Creek	250	-	-	600	27,000	93	3,360	95	6,600	927	103,889	140,849	61,239
Big Bywy Creek	250	-	-	600	27,000	93	3,360	64	4,400	927	103,889	138,649	60,282
Spring Creek	250	-	-	600	27,000	93	3,360	95	6,600	927	103,889	140,849	61,239
Apookta Creek	150	-	-	300	13,500	47	1,680	32	2,200	556	62,311	79,691	34,648
Clear Creek	500	250	16,250	1,500	67,500	155	5,600	477	33,000	1,855	207,890	330,240	143,583
Hamer Creek	300	150	9,750	900	40,300	93	3,360	286	19,800	1,113	124,734	198,144	86,150
Sand Creek	400	200	13,000	1,200	54,000	124	4,480	382	26,400	1,484	166,312	264,192	114,866
Kennison Creek	200	100	6,500	600	27,000	62	2,240	191	13,200	742	83,156	132,096	57,433
Bear-Beaver Creek (No. 1)	350	175	11,375	900	40,500	109	3,920	318	22,000	1,298	145,467	223,262	97,070
Bear-Beaver Creek (No. 4)	450	225	14,625	1,500	67,500	150	5,050	414	28,600	1,669	187,045	302,810	131,657
Subtotal	6,767	1,100	71,500	20,700	931,500	2,592	93,520	5,440	376,200	25,101	2,813,070	4,285,790	1,863,385
Single-Purpose Projects													
Zilpha Creek Reservoir[2]	1,100	550	35,750	3,388	152,934	319	11,519	1,000	69,150	2,255	252,718	522,071	226,987
Mulberry Creek Reservoir[2]	790	395	25,675	2,400	108,336	229	8,269	400	27,660	1,620	181,553	351,493	152,823
Seneatcha Creek Reservoir[2]	1,400	700	45,500	6,000	270,840	425	15,347	1,410	97,502	2,870	321,641	750,830	326,448
Big Black River Reservoir[2]	10,000	3,189	207,285	19,485	879,553	3,498	126,312	6,459	446,640	12,504	1,401,323	3,061,113	1,330,919
Tombigbee National Forest[3]	223	112	7,280	1,000	45,140	1,320	47,665	1,560	107,874	457	51,216	259,175	112,685
Holmes County State Park	-	-	-	600	27,084	250	9,028	250	17,288	-	-	53,400	35,600
Subtotal	13,513	4,946	321,490	32,873	1,483,887	6,041	218,140	11,079	766,114	19,706	2,208,451	4,996,082	2,185,462
Basin Total	20,280	6,046	392,990	53,573	2,415,387	8,633	311,660	16,519	1,142,314	44,787	5,021,521	9,283,872	4,048,847

1. Expansion of facilities considering optional 10 - 15 year development had been installed.

2. Considered for construction--if constructed, reservoir could provide indicated activity occasions with recreation development.

3. Expansion of existing facilities and development of new recreation areas.

4. Expansion of existing facilities.

BIG BLACK RIVER, MISSISSIPPI
COMPREHENSIVE BASIN STUDY

ANNEX D

A REPORT ON THE FISH AND WILDLIFE RESOURCES OF THE BIG BLACK RIVER BASIN, MISSISSIPPI

Prepared by: Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior
Southeast Region, Atlanta, Georgia

April 1968

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

April 10, 1968

Colonel Felix R. Garrett
Chairman- Coordinating Committee
Big Black River Comprehensive
Basin Study
U.S. Army, Corps of Engineers
Vicksburg, Mississippi 39181

Dear Colonel Garrett:

The Bureau of Sport Fisheries and Wildlife has completed an appraisal of fish and wildlife resources as part of its comprehensive study on the Big Black River Basin, Mississippi. In accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), we are providing information on current and projected sport fishing, hunting, and commercial fisheries demands, supply of resources, needs, and a proposed fish and wildlife plan recommended for early action. Long-range planning, as a continuing process, is also considered as a function of the study.

Basic data on supply of resources in the Big Black Basin were obtained from the following agencies: Mississippi Game and Fish Commission, Economic Research Service, U.S. Forest Service, Soil Conservation Service, and U.S. Army, Corps of Engineers. Population projections were based on the Economic Base Study developed for interagency use by Michael Baker, Incorporated.

DESCRIPTION OF AREA

The Big Black River rises in Webster County in north-central Mississippi, flows about 270 miles in a southwesterly direction, and enters the Mississippi River near Grand Gulf in Claiborne County. The drainage area is 155 miles long and averages about 22 miles in width. The narrow flood plain ranges from $\frac{1}{2}$ to $3\frac{1}{2}$ miles in width, with flood-plain lands comprising about 21 percent of the drainage area. Many small tributaries enter the mainstem of the river at fairly even intervals throughout its length. The basin includes parts of the North Central Hills, Jackson Prairie, and Loess Bluff Physiographic Regions.

The basin area is sparsely populated and is essentially an agricultural and lumbering region; however, much of the commercial timberlands have been severely cut over. There has been very little development of water resources of the Big Black River except for limited flood control purposes.

For purposes of resource appraisal, the study area of the Big Black River Basin comprises all of 10 counties and Hinds County West, as designated by the Economic Base Study.

Demand for Fishing and Hunting

For purposes of this study, only that sport fishing and hunting demand originating in the study area is considered. Demand is related to population and can, therefore, be divided in the same way. To better assess the quantity and location of both demand and supply, the basin study area was divided into two sub-areas: (1) a Northern Sub-area made up of six counties, and (2) a Southern Sub-area composed of four counties and Hinds County West (plate 1). Hinds County West includes a portion of the demand from future growth of the Jackson metropolitan area.

Per capita demand factors were derived from data extracted from the 1960 National Fishing and Hunting Survey. Although 1965 National Fishing and Hunting Survey data are now available, the minor differences in the two surveys did not warrant a revision of the calculations as presented in this report. These factors were then multiplied by the current and projected population 12 years and older in the study area to determine the man-days of fishing and hunting demand. The term "man-day" is defined as a trip for the express purpose of fishing or hunting. Because of the differences in per capita participation rates associated with place of residence, urban and rural demand were computed separately (table 2). The demand for freshwater fishing in the study area is expected to increase from 622,000 man-days in 1960 to 873,000 man-days in 2015. Hunting demand will increase from 372,000 man-days in 1960 to 464,000 man-days in 2015 (plate 2).

The current and projected demands for commercial fishery products in the basin study area were developed from current data provided by the Bureau of Commercial Fisheries. Demand projections are based on basin population increases and adjusted per capita use.

Supply of Fish and Wildlife Resources

The water and land resources of the basin sub-areas were inventoried by fish and wildlife habitat type and evaluated in terms of potential supply to provide fishing and hunting opportunities. Supply is defined as the number of annual man-days of fishing or hunting that a given resource can satisfy or sustain. The criteria are based upon (1) fish and wildlife population density per acre; (2) harvest ratio; (3) a level of success; (4) an assumed level of resource management, and (5) the extent of resource utilization. The procedures were reviewed and concurred in by the Mississippi Game and Fish Commission.

Table 1 lists the existing fish and wildlife areas and developed installations located in the Big Black River Basin study area (also see plate 1). Tables 3 and 5 show types and acreages of fish and wildlife habitat for the basin study area.

Sport Fisheries. Present-day fishery habitat in the study area totals approximately 40,000 surface acres capable of supporting an estimated 819,000 man-days of fishing (table 3 and plate 3). Natural lakes and streams account for 56 percent of the total fishing area in the basin, and 60 percent of the potential man-day capability to satisfy fishing demand.

The average man-day-per-acre values for the various habitat types were established in cooperation with biologists of the Mississippi Game and Fish Commission. The evaluations were based on the productivity of the water types, a harvest of 25 percent of the standing crop of fish, and the allowance of 2 pounds of fish per man-day. Standards for minimum acceptable catch were set by considering various influencing factors such as location, type of fishing, tolerance to crowding or disturbance, past fishing experience, and availability of alternative fishing. The resulting factors, shown in footnote 2, table 3, were used in determining the total man-days of supply afforded by the habitat types (tables 6-8).

The supply of sport-fishing habitat in the Big Black basin is not expected to increase greatly in future years. The anticipated increase would result primarily from continued construction of farm ponds by private landowners and the installation of floodwater-retarding structures under the Soil Conservation Service small watershed program.

Wildlife. The basin study area now contains a total of approximately 4,047,800 acres of habitat suitable for wildlife production capable of providing a potential 1,748,700 man-days of hunting opportunities (plate 4). About 28 percent of the hunting potential is provided by bottom-land hardwood forest, including valuable wetland areas which offer the highest quality wildlife habitat and most diversified hunting opportunities.

The inventory of wildlife habitat types was based on the present and future land-use acreages compiled through cooperative study efforts by the Department of Agriculture (table 5). The four types of forest land and the two types of cleared land were considered to have notable differences in value as wildlife habitat. The potential man-day evaluation per 1,000 acres of habitat type was based on wildlife population density, percent annual harvest, and man-days of effort per kill (table 4).

For planning purposes, the supply of wildlife resources was evaluated at two separate levels of use. The available supply of resources recognizes the restrictions of hunting opportunity under existing conditions. In 1960 it was assumed that the available supply was equal to the use or demand for hunting in the basin study area. Limitations on resource use result from unequal distribution of supply and demand, land posting, intolerance to hunter crowding, slow acceptance of liberalized hunting regulations, and hunter preference by type of hunting. These and other factors combined are expected to prevent complete utilization of wildlife resources now or in the immediate future.

The potential supply of wildlife resources represents an expected realizable level in management and unrestricted use. Adequate funds are assumed to be available to achieve the goals of management. Complete utilization of the resource would require all the habitat to be available for management and sustained harvest.

Hunting pressures (use) would have to be so distributed and exerted to such a degree that the population of each wildlife species is reduced to the level desired for the best management of the habitat, and to produce a sustained annual harvest level. Considering these criteria, it is therefore concluded that it will be unusual for the potential to be obtained in a basinwide situation, although for more restricted areas such as lands owned by the State Game and Fish Commission, this potential may be approached. It is also possible and should be considered a part of planning, that some increase will be achieved above the available supply, due to partial or total removal of some of the limiting factors.

These variable aspects of wildlife supply were taken into consideration in the development of the available and potential man-day factors shown in table 4. The appropriate supply factor (table 4) multiplied by the corresponding acreage of habitat will result in the total man-days of supply afforded by the habitat types (tables 9-11) for 1960, 1980, and 2015.

Waterfowl were not included in calculations of hunting supply, although waterfowl hunting occurs in the natural lakes and overflow bottoms along the Big Black River. Present available supplies of waterfowl are below those needed to meet demand throughout the basin, and preservation and management of selected habitat areas can be expected to satisfy only a portion of future demand.

Without careful planning, the capability of land habitat to support wildlife resources is expected to decline in future years, primarily through land-use changes (plate 5 and table 5). An estimated loss of approximately 199,500 acres by 1980 and 571,200 acres by 2015 of valuable bottomland hardwood habitat is expected, thus reducing potential hunting opportunities for big game, small game, and waterfowl.

Bird watching and wildlife photography opportunities represent another important asset provided by the wildlife resources in the basin. However, these opportunities are not expected to materially increase as a result of project developments in the basin.

Commercial Fisheries. The estimated 1959-60 harvest of commercial fish for the Big Black River basin is given in table 12. Nine regular fishermen and 44 casual fishermen caught 200,000 pounds of fish, valued at $35,000. This represents a harvest of the wild resource from natural waters, primarily Big Black main stem and natural lakes. Fish-farming activities are not significant in the basin drainage area at the present time, but future growth is expected. Economically important fish-farming operations currently exist in the adjoining Yazoo River basin. The supply of commercial fish as a wild resource in the Big Black basin is

not expected to increase greatly in future years. However, improved management and utilization of existing resources are expected. Improved access developments, recommended for sport fishing, will also provide for commercial-fishing activities.

Fish and Wildlife Needs

Sport Fisheries. Existing and projected needs for fishing were determined by comparing the demand for, and the supply of, fishery resources (tables 6-8). Based on this comparison, there is no indication of gross fishing needs for the basin sub-areas by 1980. By 2015, however, it is anticipated that 35,000 additional man-days of fishing opportunity will be needed in the Northern Sub-area of the basin.

Wildlife. Expected needs for additional hunting opportunity are greater than those for fishing, due in part to restrictive factors which tend to limit public hunting to a greater degree than public fishing. Comparison of hunting demand and the available supply indicates that 20,000 man-days of hunting needs were present in the Southern Sub-area of the basin in 1960 (table 9). By 1980, hunting needs in the Southern Sub-area will increase to a predicted 27,000 man-days, and in 2015 hunting needs will total 22,000 and 127,000 man-days, respectively, for the Northern and Southern Sub-areas of the basin (tables 10-11). At the potential level of supply, the demand for hunting could be satisfied throughout the period of analysis.

Commercial Fisheries. Future needs for commercial fish can be predicted by comparing the 1980 and 2015 requirements with the 1960 harvest of 200,000 pounds of fish (table 13). Demand will exceed the 1960 harvest by 40 percent in 1980, and 100 percent in 2015.

Meeting Future Fish and Wildlife Needs

Sport Fisheries. Although gross fishing needs for the basin sub-areas are not indicated by 1980, limited use of the early action reservoirs planned by the Soil Conservation Service can be expected. The developments will tend to satisfy localized needs by the better distribution of supply. Structure design of the multi-purpose reservoirs should provide for water-level manipulation needed for fishery management, and access facilities should be adequate for fishing use. Specific recommendations regarding fishery management will be made during detailed studies of projects authorized for construction.

To maintain diversity in the type of fishing water in the Big Black basin, certain fishing streams should be protected from channelization works. For example, Doaks Creek in Madison County and Big Sand Creek in Claiborne County are of sufficient fishing value to warrant consideration in this regard. In addition to preservation, provision for adequate public access to these streams will be necessary for the resources to be fully utilized. The number of access sites will be determined and

detailed recommendations regarding fishery developments will be made when these watersheds are authorized for planning.

There is also a need for public access developments on the Big Black River mainstem and certain natural lakes in the basin. Provision for a number of sites, to be determined by detailed studies, should be included in any future plan of flood-control development for the Big Black Basin. The access afforded by such sites would allow better utilization of both fish and wildlife resources.

Wildlife. The estimated 27,000 man-day need for hunting in 1980 and the increased 149,000 man-day deficit in 2015 will occur under without-project conditions, due to increased population demand and the adverse effects of predicted land-use changes on wildlife habitat.

Proposed early-action projects for the basin will result in the inundation of 16,100 acres of land area and the clearing of 21,800 acres of valuable bottom-land hardwood habitat, thereby expanding the 1980 need for upland-game hunting by approximately 17,000 man-days (table 16). The 21,800 acres of land clearing alone amount to 4.7 percent of the projected bottom-land hardwood acreage in 1980 and 23 percent of the remaining bottom-land hardwood in 2015. Only incidental wildlife benefits, in the form of waterfowl hunting, will accrue to the proposed reservoir projects. Wildlife area improvements planned in SCS watershed projects have been given consideration, in that projected cleared land acreages have been assigned the maximum values for hunting opportunities at the potential level. This provides a comparison of potential habitat value between the cleared land and the woodland habitat lost as a result of proposed projects.

In view of the magnitude of project-induced wildlife losses compared to wildlife benefits, construction project plans should include appropriate mitigatory measures. It is recommended that the project or project sponsors make available to the Mississippi Game and Fish Commission 23,000 acres of bottom-land hardwood habitat for wildlife management purposes. The assurance of wildlife management and hunter use of these lands would mitigate the 17,000 man-days of hunting losses resulting from land inundation by reservoirs and project-induced land clearing. Actual replacement of the wildlife habitat lost would involve reestablishment of the specified acreage of bottom-land forest on cleared land. The process of producing such a forest of significant value to wildlife would require a period of 50 to 75 years and is not considered a practicable objective of this study.

Future hunting needs anticipated under without-project conditions may be satisfied in part by intensified management and utilization of existing public lands. However, less than 5 percent of the total wildlife habitat in the Big Black Basin is under any form of public ownership,

including wildlife refuges and all 16th section school lands. In the basin study area, 16th section "forest lands" presently constitute 46,489 acres. Much of this land is not under private lease and offers opportunities for public fishing and hunting use.

Due to the limited public wildlife facilities in the basin study area, hunting opportunity on private land will continue to be an important factor in relation to satisfying future hunting demand. Landowners should therefore be encouraged to initiate wildlife-habitat improvement practices. In areas of high demand, fee hunting facilities, such as dove shooting fields, would help satisfy hunting needs and also provide the landowner with supplemental income. On retired agriculture land, assistance to landowners is available for wildlife improvements under the Food and Agriculture Act of 1965. Areas thus improved would be open to the public for hunting.

An additional means of providing for future hunting needs in the Big Black Basin would be the expansion of wildlife-management areas by the Mississippi Game and Fish Commission. Lands for this purpose could possibly be in association with, or expansion of, project lands acquired as mitigation for project-induced wildlife losses. Consideration should be given to upland-game areas or waterfowl developments. Approximately 27,000 acres of bottomland hardwood, managed for upland game, would tend to satisfy the 1980 without-project need. Particular emphasis should be given to the preservation of existing high quality habitat types, such as bottomland-hardwood areas.

Commercial Fisheries. To satisfy future commercial fishery needs in the basin study area, consideration should be given to such factors as (1) revision or removal of restrictive laws and regulations governing commercial fishing; (2) establishment of fish-farming operations to supplement production from natural waters; (3) improvement of water-quality conditions; (4) improvement of fishing techniques; and (5) improvement of processing and marketing operations. Planning for water-development projects in the basin should, therefore, consider the water requirements for future expansion of fish-farming activities.

Allocation of Fish and Wildlife Benefits to Proposed Projects

Fish. Only a slight increase in fishing demand is anticipated for the Big Black Basin by 1980. Early-action reservoirs planned for 1980 are, therefore, expected to receive only limited use initially, and moderate utilization by 2015.

The allocation of fishing benefits to the proposed early-action reservoir projects is shown in table 14. The anticipated increased use of the projects by 2015 is also shown. Reservoir fishing, as indicated in footnote 1, is valued at $1.00 per man-day.

A tabulation of proposed late-action projects and surface acres of water appear in table 15.

Wildlife. Incidental wildlife benefits, in the form of waterfowl hunting, will accrue to the proposed early-action and late-action reservoir projects. The estimated man-day allocation and monetary evaluation of these benefits are shown in table 16 for the early-action projects.

In contrast to the minor waterfowl benefits, upland-game losses will be substantial, due to the inundation of land area and the clearing of bottom-land hardwood habitat. Early-action projects will result in significant losses to wildlife, as indicated in table 16. To offset this project-induced loss suitable project lands should be made available to the Mississippi Game and Fish Commission for wildlife purposes. The extent of wildlife habitat affected by the proposed late-action projects is shown in table 17.

The early-action plan designed to maintain quality fishing and hunting in the Big Black River Basin is discussed in the following section. Long-range planning for fish and wildlife will involve a continuation of the early-action proposals with the introduction of new proposals as the need arises. Consideration should be given to providing for reservoir management, stream preservation, additional public-access facilities, expansion of public wildlife areas, and more intensive management and utilization of existing public lands and water.

Planning for Fish and Wildlife Early Action

At the basin or sub-area level, the existing supply of sport-fishery resources is adequate to supply the present and early future demands for fishing. There is a need for improved management and access development, particularly on natural waters. Localized needs for fishing will occur where gross needs are not apparent. Early-action reservoir projects planned by the Soil Conservation Service will more than satisfy the anticipated local needs for fishing.

The potential supply of wildlife resources in the Big Black Basin is adequate to support anticipated hunting demands throughout the period of analysis. However, due to restrictions on the use of resources, needs for additional hunting opportunity exist now and are expected to increase slightly by 1980. These needs can best be met by increased wildlife management and efforts to minimize the effects of hunting restrictions now imposed at the available supply level. Early-action construction projects planned by the Soil Conservation Service will induce substantial wildlife losses and provide only limited wildlife benefits.

Specific recommendations regarding the protection and management of resources will be made during the detailed study of future authorized construction projects. In general terms, however, the following steps would tend to provide for localized fish and wildlife needs:

Fish.

1. Include provisions for adequate fishery management and fisherman use of all reservoir projects proposed for early action by the Soil Conservation

Service. The reservoirs can provide for better distribution of fishing opportunities throughout the basin and adequately satisfy local needs for the target years 1980 and 2015.

2. Maintain diversity in the type of fishing in the basin by the preservation of certain fishing streams.

3. Provide for improved access development on streams and lakes in the basin, the number of sites and locations to be determined during the detailed study of any authorized construction project.

Wildlife.

4. Make available to the Mississippi Game and Fish Commission lands as described in this report as mitigation for project-induced wildlife losses (table 16). Approximately 23,000 acres of bottom-land hardwood habitat, managed for wildlife purposes, would be required to offset the 17,000 man-day loss. Detailed studies during individual project analysis would be required to determine specific proposals regarding the type of wildlife development.

5. Establish public wildlife areas to satisfy a portion of the hunting needs anticipated in the Southern Sub-area of the basin by 1980. Lands for this purpose could be in association with, or expansion of, project lands acquired in mitigating wildlife losses.

6. Intensify management and utilization of existing public lands and wildlife-management areas; i.e., 16th section "forest lands" not under private lease and the Choctaw Wildlife Management Area.

7. Encourage private landowners to install wildlife developments for public use. Examples: dove-shooting fields on a fee basis and wildlife-food plantings on retired agricultural land.

8. Coordinate the fish and wildlife features of future authorized construction projects with the Mississippi Game and Fish Commission and other interested agencies.

This report has been reviewed and concurred in by the Bureau of Commercial Fisheries and the Mississippi Game and Fish Commission. A copy of the comments from the State agency is attached.

We appreciate the opportunity to submit this fish and wildlife report for consideration in developing a comprehensive plan of improvement for the Big Black Basin.

Sincerely yours,

C. Edward Carlson

C. Edward Carlson
Regional Director

Attachments

Table 1
Existing Fish and Wildlife Areas and Installations
Big Black River Study Area 1/

Federal Areas	Administrative Agency	Total Acres	Wetland Acres	Water Acres	Activity or Purpose
Davis Island WL Refuge	BSF&W	70	-	-	WP
Tombigbee Natl Forest 2/	USFS	11,213	-	116	WP, F&H
Natchez Trace Parkway	NPS	13,860	-	-	WP
Vicksburg Natl Mil.Pk.	NPS	1,339	-	-	WP
State Areas					
Choctaw WL Mgt Area 2/	MG&FC	17,000	-	-	WP, H&F
Pearl River W/F Ref.	MG&FC	1,200	900	-	WP&H
Holmes Co. State Pk.	MSPC	510	-	60	WP&F
County Areas					
16th Sections	CBS	46,489(Forestland)		-	WP, H&F
Raymond Lake	Hinds Co	65	-	50	F

Legend: BSF&W - Bureau of Sport Fisheries and Wildlife
USFS - U. S. Forest Service
MG&FC - Miss. Game & Fish Comm.
MSPC - Miss. State Parks Comm.
WP - Wildlife Production
F - Fishing
H - Hunting
CBS - County Board of Supervisors

1/ Refer to plate 1; study area consists of 10 counties and Hinds Co. West

2/ Total acreage within Choctaw County includes 11,213 acres of Tombigbee National Forest.

Table 2

Existing and Projected Population and Demand by Sub-areas 1/

Big Black Basin

(Thousands)

Area	Total Population 1960	1980	2015	Population 12 and Over 1960	1980	2015
Basin study area	241.9	248.5	379.0	170.4	174.1	262.6
Urban portion	72.9	100.0	219.4	51.3	70.1	152.0
Rural portion	169.0	148.5	159.6	119.1	104.0	110.6

Man-Days (Thousands) 2/

	Fishing Demand			Hunting Demand		
Northern Sub-area	246	243	345	154	145	191
Southern Sub-area	376	371	528	218	208	273
Basin study area	622	614	873	372	353	464
Urban portion	145	198	430	59	80	173
Rural portion	477	416	443	313	273	291

1/ Refer to plate 1.

2/ Demand calculated from population 12 years and over.

Man-days per capita fishing demand		Man-days per capita hunting demand
Urban	2.83	Urban - 1.14
Rural	4.00	Rural - 2.63

Table 3

Existing and Projected Supply of Sport-Fishery Habitat

By Sub-Areas 1/

Big Black River Basin

Habitat Type 2/	Acres of Habitat 3/		
Northern Sub-area	1960	1980	2015
Farm ponds	5,386	6,034	7,190
Flood-detention res.	3,461	3,461	3,461
Artificial lakes:			
Managed	382	382	382
Unmanaged	317	317	317
Natural lakes	2,355	2,355	2,355
Streams	3,645	3,645	3,645
Total	15,546	16,194	17,350
Southern Sub-area			
Farm ponds	6,596	7,389	8,806
Flood-detention res.	454	454	454
Artificial lakes:			
Managed	267	267	267
Unmanaged	689	689	689
Natural lakes	10,713	10,713	10,713
Streams	5,469	5,469	5,469
Total	24,188	24,981	26,398
Basin Study Area			
Farm ponds	11,982	13,423	15,996
Flood-detention res.	3,915	3,915	3,915
Artificial lakes:			
Managed	649	649	649
Unmanaged	1,006	1,006	1,006
Natural lakes	13,068	13,068	13,068
Streams	9,114	9,114	9,114
Total	39,734	41,175	43,748

1/ Refer to plate 1

2/ Man-day per acre supply for habitat types: Farm ponds - 20; flood-detention res. - 10; managed lakes - 50; unmanaged lakes - 20; natural lakes - 30; streams: Northern Sub-area - 10; Southern Sub-area - 11.

3/ Inventory based on publications of the Mississippi Game and Fish Commission, maps of the study area, and U.S.D.A. data on the Yazoo River Watershed, P.L. 566 Watersheds, and farm ponds.

Table 4

Evaluation of Wildlife Resource Supply - Realizable Potentials

Wildlife Density per 1,000 Acres

Big Black River Basin Study Area

Big Game	Pine	Pine Hardwood	Upland Hardwood	Bottomland Hardwood	Cropland	Pasture	Annual Harvest(%)	Man Days per Kill
Deer	17	20	25	30	-	-	30%	25.0
Turkey	5	7	10	12	-	-	50%	25.0
Small Game								
Squirrel	100	130	200	330	-	-	60%	.66
Rabbits	100	140	200	250	330	250	70%	.83
Raccoon	7	10	20	50	-	-	50%	2.0
Fox	7	10	10	13	-	-	60%	2.5
Quail	40	50	50	50	250	130	60%	.66
Dove	-	-	-	-	130	70	50%	.4

Man-Day Hunting Supply Levels

(Per 1,000 Acres)

Habitat	Big Game	Small Game	Potential Level[1/]	Available Level[2/]
Pine	190	131	321	67
Pine Hardwood	238	177	415	89
Upland Hardwood	313	250	563	120
Bottomland Hardwood	375	365	740	157
Cropland	-	317	317	67
Pasture	-	210	210	44

1/ Potential supply per 1,000 acres realized with future planning and removal of present restrictions on opportunities.

2/ Available supply per 1,000 acres under present conditions without future planning and without removal of present restrictions on opportunities.

Table 5
Existing and Projected Land Use Types [1]
by Sub-Areas [2]
Big Black River Basin

Land Use Type	Acres of Habitat (Thousands) 1960	1980	2015
Northern Sub-area			
Forest Land	1,302.5	1,369.9	1,472.9
Pine	426.0	513.3	610.2
Pine hardwood	223.9	253.1	366.5
Upland hardwood	448.7	460.5	466.5
Bottomland hardwood	203.9	143.0	29.7
Cleared Land	662.6	664.1	619.7
Cropland	413.6	400.7	348.5
Pasture	249.0	263.4	271.2
Total	1,965.1	2,034.0	2,092.6
Southern Sub-area			
Forest Land	1,173.3	1,098.7	958.5
Pine	168.2	202.6	240.8
Pine hardwood	147.4	166.6	241.3
Upland hardwood	393.1	403.5	408.8
Bottomland hardwood	464.6	326.0	67.6
Cleared Land	909.4	910.4	849.4
Cropland	569.6	551.1	479.4
Pasture	339.8	359.3	370.0
Total	2,082.7	2,009.1	1,807.9
Basin Study Area			
Forest Land	2,475.8	2,468.6	2,431.4
Pine	594.2	715.9	851.0
Pine hardwood	371.3	419.7	607.8
Upland hardwood	841.8	864.0	875.3
Bottomland hardwood	668.5	469.0	97.3
Cleared Land	1,572.0	1,574.5	1,469.1
Cropland	983.2	951.8	827.9
Pasture	588.8	622.7	641.2
Total	4,047.8	4,043.1	3,900.5

1/ Based on cooperative study efforts between the Economic Research Service, Soil Conservation Service, and U. S. Forest Service.

2/ Refer to plate 1.

Table 6

Fishing Demand in Relation to Supply of Sport Fishery Resources
by Sub-Areas
Big Black River Basin
1960

Habitat Type	Acres	Man-Days (Thousands) Demand	Supply	Needs 1/
Northern Sub-area				
Farm ponds	5,386		108	
Flood-detention res.	3,461		34	
Artificial lakes:				
Managed	382		19	
Unmanaged	317		6	
Natural lakes	2,355		71	
Streams	3,645		36	
Total	15,546	246	274	0
Southern Sub-area				
Farm ponds	6,596		132	
Flood-detention res.	454		5	
Artificial lakes:				
Managed	267		13	
Unmanaged	689		14	
Natural lakes	10,713		321	
Streams	5,469		60	
Total	24,188	376	545	0
Basin Study Area				
Farm ponds	11,982		240	
Flood-detention res.	3,915		39	
Artificial lakes:				
Managed	649		32	
Unmanaged	1,006		20	
Natural lakes	13,068		392	
Streams	9,114		96	
Total	39,734	622	819	0

1/ Unsatisfied demand without project planning.

Table 7

Fishing Demand in Relation to Supply of Sport Fishery Resources
by Sub-Areas
Big Black River Basin
1980

Habitat Type	Acres	Man-Days (Thousands) Demand	Supply 2/	Needs 1/
Northern Sub-area				
Farm ponds	6,034		121	
Flood-detention res.	3,461		34	
Artificial lakes:				
Managed	382		19	
Unmanaged	317		6	
Natural lakes	2,355		71	
Streams	3,645		36	
Total	16,194	243	287	0
Southern Sub-area				
Farm ponds	7,389		147	
Flood-detention res.	454		5	
Artificial lakes				
Managed	267		13	
Unmanaged	689		14	
Natural lakes	10,713		321	
Streams	5,469		60	
Total	24,981	371	560	0
Basin Study Area				
Farm ponds	13,423		268	
Flood-detention res.	3,915		39	
Artificial lakes:				
Managed	649		32	
Unmanaged	1,006		20	
Natural lakes	13,068		392	
Streams	9,114		96	
Total	41,175	614	847	0

1/ Unsatisfied demand without project planning.
2/ Supply increased by farm pond construction.

Table 8

Fishing Demand in Relation to Supply of Sport Fishery Resources
by Sub-Areas
Big Black River Basin
2015

Habitat Types	Acres	Man-Days (Thousands) Demand	Supply[1]	Needs[2]
Northern Sub-area				
Farm ponds	7,190		144	
Flood-detention res.	3,461		34	
Artificial lakes:				
Managed	382		19	
Unmanaged	317		6	
Natural lakes	2,355		71	
Streams	3,645		36	
Total	17,350	345	310	35
Southern Sub-area				
Farm ponds	8,806		176	
Flood-detention res.	454		5	
Artificial lakes:				
Managed	267		13	
Unmanaged	689		14	
Natural lakes	10,713		321	
Streams	5,469		60	
Total	26,398	528	589	0
Basin Study Area				
Farm ponds	15,996		320	
Flood-detention res.	3,915		39	
Artificial lakes:				
Managed	649		32	
Unmanaged	1,006		20	
Natural lakes	13,068		392	
Streams	9,114		96	
Total	43,748	873	899	0

1/ Supply increased by farm-pond construction.
2/ Unsatisfied demand without project planning.

Table 9

Hunting Demand in Relation to Supply of Wildlife Resources
by Sub-Areas
Big Black River Basin
1960

Habitat Type	(Thousands) Acres	Demand	Man-Days (Thousands) Supply Avail.	Supply Potential	Needs 1/ Avail.	Needs 1/ Potential
Northern Sub-area						
Forest Land	1,302.5		135.0	633.1		
Pine	426.0		29.0	136.7		
Pine hardwood	223.9		20.0	92.9		
Upland hardwood	448.7		54.0	252.6		
Bottomland hardwood	203.9		32.0	150.9		
Cleared Land	662.6		39.0	183.4		
Cropland	413.6		28.0	131.1		
Pasture	249.0		11.0	52.3		
Total	1,965.1	154.0	174.0	816.5	0	0
Southern Sub-area						
Forest Land	1,173.3		145.0	680.3		
Pine	168.2		12.0	54.0		
Pine hardwood	147.4		13.0	61.2		
Upland hardwood	393.1		47.0	221.3		
Bottomland hardwood	464.6		73.0	343.8		
Cleared Land	909.4		53.0	251.9		
Cropland	569.6		38.0	180.6		
Pasture	339.8		15.0	71.3		
Total	2,082.7	218.0	198.0	932.2	20.0	0
Basin Study Area						
Forest Land	2,475.8		280.0	1,313.4		
Pine	594.2		41.0	190.7		
Pine hardwood	371.3		33.0	154.1		
Upland hardwood	841.8		101.0	473.9		
B/L hardwood	668.5		105.0	494.7		
Cleared Land	1,572.0		92.0	435.3		
Cropland	983.2		66.0	311.7		
Pasture	588.8		26.0	123.6		
Total	4,047.8	372.0	372.0	1,748.7	0	0

1/ Unsatisfied demand without project planning.

Table 10
Hunting Demand in Relation to Supply of Wildlife Resources
by Sub-Areas
Big Black River Basin
1980

Habitat Type	(Thousands) Acres	Demand	Man-Days (Thousands) Supply Avail.	Supply Potential	Needs[1] Avail.	Needs[1] Potential
Northern Sub-area						
Forest Land	1,369.9		134.7	634.9		
Pine	513.3		34.4	164.8		
Pine hardwood	253.1		22.5	105.0		
Upland hardwood	460.5		55.3	259.3		
B/L hardwood	143.0		22.5	105.8		
Cleared Land	664.1		38.4	182.3		
Cropland	400.7		26.8	127.0		
Pasture	263.4		11.6	55.3		
Total	2,034.0	145.0	173.1	817.2	0	0
Southern Sub-area						
Forest Land	1,098.7		128.0	602.4		
Pine	202.6		13.6	65.0		
Pine hardwood	166.6		14.8	69.0		
Upland hardwood	403.5		48.4	227.2		
B/L hardwood	326.0		51.2	241.2		
Cleared Lands	910.4		52.7	250.2		
Croplands	551.1		36.9	174.7		
Pasture	359.3		15.8	75.5		
Total	2,009.1	208.0	180.7	852.6	27.3	0
Basin Study Area						
Forest Land	2,468.6		262.7	1,237.3		
Pine	715.9		48.0	229.8		
Pine hardwood	419.7		37.3	174.0		
Upland hardwood	864.0		103.7	486.5		
B/L hardwood	469.0		73.7	347.0		
Cleared Land	1,574.5		91.1	432.5		
Cropland	951.8		63.7	301.7		
Pasture	622.7		27.4	130.8		
Total	4,043.1	353.0	353.8	1,669.8	0	0

1/ Unsatisfied demand without project planning.

Table 11
Hunting Demand in Relation to Supply of Wildlife Resources by Sub-Areas
Big Black River Basin
2015

Habitat Type	(Thousands) Acres	Demand	Man-Days (Thousands) Supply Avail.	Supply Potential	Needs 1/ Avail.	Needs 1/ Potential
Northern Sub-area						
Forest Land	1,472.9		134.2	636.6		
Pine	610.2		40.9	195.9		
Pine hardwood	366.5		32.6	152.1		
Upland hardwood	466.5		56.0	262.6		
B/L hardwood	29.7		4.7	22.0		
Cleared Land	619.7		35.2	167.5		
Cropland	348.5		23.3	110.5		
Pasture	271.2		11.9	57.0		
Total	2,092.6	191.0	169.4	800.1	21.6	0
Southern Sub-area						
Forest Land	958.5		97.3	457.6		
Pine	240.8		16.1	77.3		
Pine hardwood	241.3		21.5	100.1		
Upland hardwood	408.8		49.1	230.2		
B/L hardwood	67.6		10.6	50.0		
Cleared Land	849.4		48.4	229.7		
Cropland	479.4		32.1	152.0		
Pasture	370.0		16.3	77.7		
Total	1,807.9	273.0	145.7	687.3	127.3	0
Basin Study Area						
Forest Land	2,431.4		231.5	1,090.2		
Pine	851.0		57.0	273.2		
Upland hardwood	607.8		54.1	252.2		
Pine hardwood	875.3		105.1	492.8		
Bottomland hardwood	97.3		15.3	72.0		
Cleared Land	1,469.1		83.6	397.2		
Cropland	827.9		55.4	262.5		
Pasture	641.2		28.2	134.7		
Total	3,900.5	464.0	315.1	1,487.4	148.9	0

1/ Unsatisfied demand without project planning.

Table 12
Commercial Fisheries Harvest-Natural Waters
Big Black River Basin Study Area
1959-60

Species	Catch in Lbs.	Value
Buffalo	112,900	$ 16,700*
Carp	21,100	850*
Drum	9,400	700*
Blue/Channel Catfish	18,400	5,700*
Flathead Catfish	37,200	10,800*
Paddlefish	1,000	150*
Total	200,000	$ 34,900

Fishermen	Number
Regular	9 (2)
Casual	44 (6)

Gear	
Trammel net	1
Gill net	4
Hoop net	462(40)
Trotline	41(7)
Snagline	19(6)
Boats	34(5)
Motors	34(5)

Note: Values for species, followed by *, are pro-rated estimates derived from the values for each species as given in the 1960 "Fishery Statistics of the U.S." page 427, Section Mississippi-Catch by Waters(Inland Lakes & Streams). Only the $35,000 total value appeared in the table furnished by the Mississippi Game & Fish Commission.

Numbers in parentheses are duplications from other waters.

Table 13
Projected Commercial Fishery Requirements 1/
Big Black River Basin

Species	Thousands of Pounds		
	1960	1980	2015
Buffalo	113	134	170
Carp	21	26	34
Drum	9	11	14
Catfish	56	110	182
Paddlefish	1	1	1
Total	200	282	401

1/ 1960 estimates based on catch from natural waters. Projected demand based on population increase and adjusted per capita demand. Basic data provided by Bureau of Commercial Fisheries, St. Petersburg, Fla.

Table 14
Proposed Early Action Water Developments 1/
Big Black River Basin

Projects	Planning Agency	Surface Acres	Man-Days 2/ Fishing Use 1980	2015
Northern Sub-Area				
Multi-purpose res.:				
Spring Creek (site 3)	SCS	250	3,000	4,000
Big Bywy Creek (site 3)	SCS	250	3,000	4,000
Poplar Creek (site 4)	SCS	250	3,000	4,000
Poplar Creek (site 4)	SCS	200	2,000	3,000
Peachahala Creek (site 4)	SCS	150	2,000	3,000
Long Creek (site 12)	SCS	267	3,000	5,000
Sub-total		1,367	16,000	23,000
Flood-detention res.:				
No. structures - 120	SCS	5,387	16,000	27,000
Southern Sub-Area				
Multi-purpose res.:				
Big Cypress Cr.(site 18)	SCS	250	1,000	2,000
Doaks Creek (site 9)	SCS	250	1,000	2,000
Panther-H. Moss Cr.(site 1)	SCS	500	3,000	3,000
Bogue Chitto Cr.(site 8)	SCS	500	3,000	3,000
Bogue Chitto Cr.(site 3)	SCS	250	1,000	2,000
Porter-Cox Cr.(site 6)	SCS	300	2,000	2,000
Baheis Cr. (site 1)	SCS	259	1,000	2,000
Baheis Cr. (site 5)	SCS	225	1,000	1,000
Fourteen Mile Cr.(site 7)	SCS	200	1,000	1,000
Fourteen Mile Cr.(site 2)	SCS	300	2,000	2,000
Five Mile Creek(site 4)	SCS	175	1,000	1,000
Sub-total		3,200	17,000	21,000
Flood-Detention Res.:				
No. structures - 67	SCS	6,161	6,000	6,000
Basin Study Area				
Multi-purpose Res.	SCS	4,567	33,000	44,000
Flood-detention Res.	SCS	11,548	22,000	33,000

1/ Includes PL 566 watershed projects for authorization by 1980.
2/ Reservoir fishing valued at $1.00 per man-day.

Table 15
Proposed Late Action Water Developments
Big Black River Basin
2015

Projects	Planning Agency	Surface Acres
Southern Sub-area		
Multi-purpose Res.:		
Bear-Beaver Creek (site 1)	SCS	350
Bear-Beaver Creek(site 4)	SCS	450
Clear Creek (site 2)	SCS	500
Hamer Creek (site 4)	SCS	300
Big Sand Creek (site 3)	SCS	400
Kennison Creek (site 4)	SCS	200
Sub-total		2,200
Flood-Detention Res.:		
No. Structures - 22	SCS	766
Basin Study Area		
Multi-purpose Res.	SCS	2,000
Flood-detention Res.	SCS	766

Table 16
Effects of Early Action Projects on Wildlife
Big Black Basin
1980

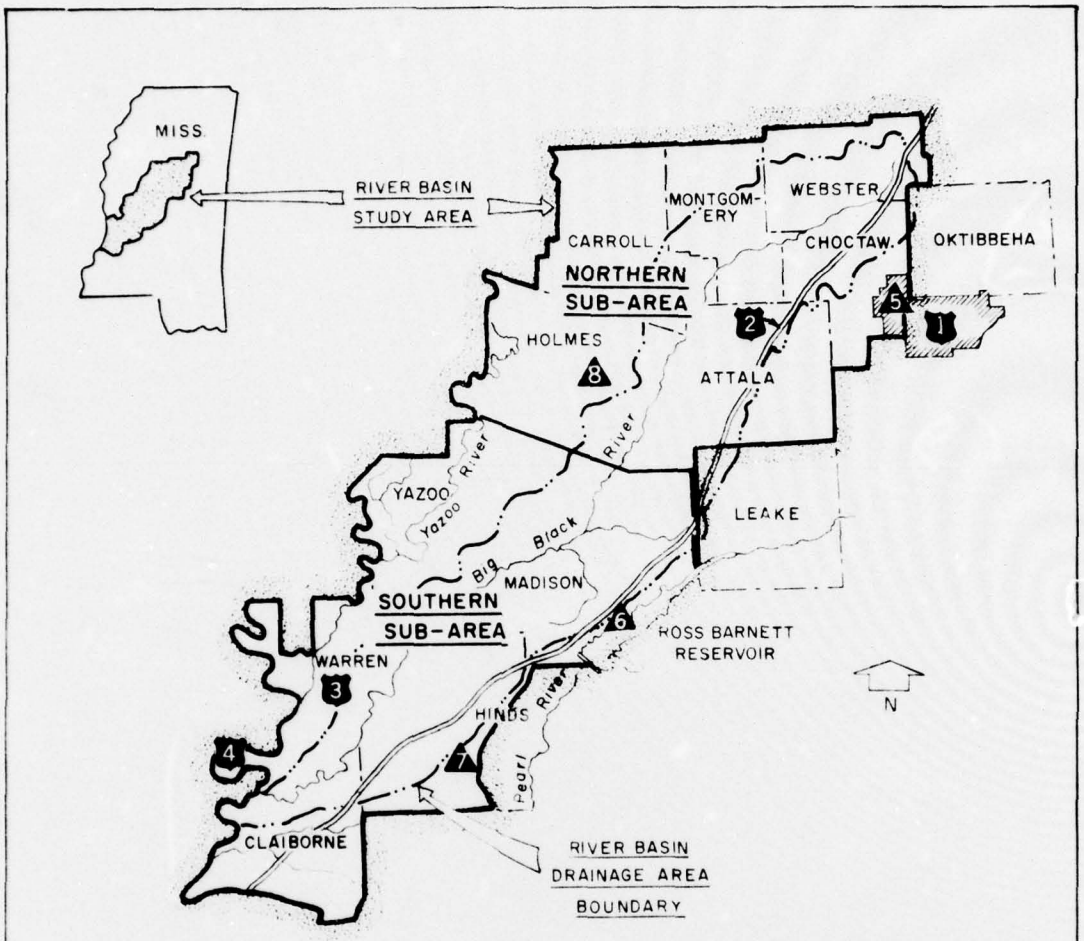
Projects	Acres of Habitat		M/D of Hunting[1/]		Value
	Inundated	Cleared	Upland Game Loss	Waterfowl Benefits	Waterfowl Benefits
Northern Sub-area					
SCS Multi-purpose Res.	1,367	-	600	100	$ 300
SCS Flood-detention Res.	5,387	-	2,400	600	1,800
SCS Woodland Converted		4,940	2,400	-	-
Mainstem Land Clearing		6,075	2,900	-	-
Sub-total	6,754	11,015	8,300	700	$2,100
Southern Sub-area					
SCS Multi-purpose Res.	3,200	-	1,200	300	900
SCS Flood-detention Res.	6,161	-	2,400	600	1,800
SCS Woodland Converted		8,244	4,000	-	-
Mainstem Land Clearing		2,560	1,200	-	-
Sub-total	9,361	10,804	8,800	900	$2,700
Grand Total	16,115	21,819	17,100	1,600	$4,800

1/ Upland game loss due to inundation of land area and clearing of bottomland-hardwood habitat.

Waterfowl benefits are .10 man-days per acre of reservoir area, valued at $3.00 per man-day.

Table 17
Effects of Late Action Projects on Wildlife Habitat
Big Black Basin
2015

Projects	Acres of Habitat Inundated	Acres of Habitat Cleared
Southern Sub-area		
SCS Multi-purpose reservoir	2,200	
SCS Flood-detention reservoir	766	
SCS Woodland conv.	———	1,152
Total	2,966	1,152



FISH and WILDLIFE INSTALLATIONS

FEDERAL AREAS

1. TOMBIGBEE NATIONAL FOREST
2. NATCHEZ TRACE PARKWAY
3. VICKSBURG NAT'L. MIL. PARK
4. DAVIS ISLAND NAT'L. WILDLIFE REFUGE

STATE AREAS

5. CHOCTAW WILDLIFE MGT. AREA (Choctaw Co. Portion)
6. PEARL RIVER WATERFOWL REFUGE
7. RAYMOND LAKE
8. HOLMES CO. STATE PARK

BIG BLACK RIVER DRAINAGE BASIN
MISSISSIPPI

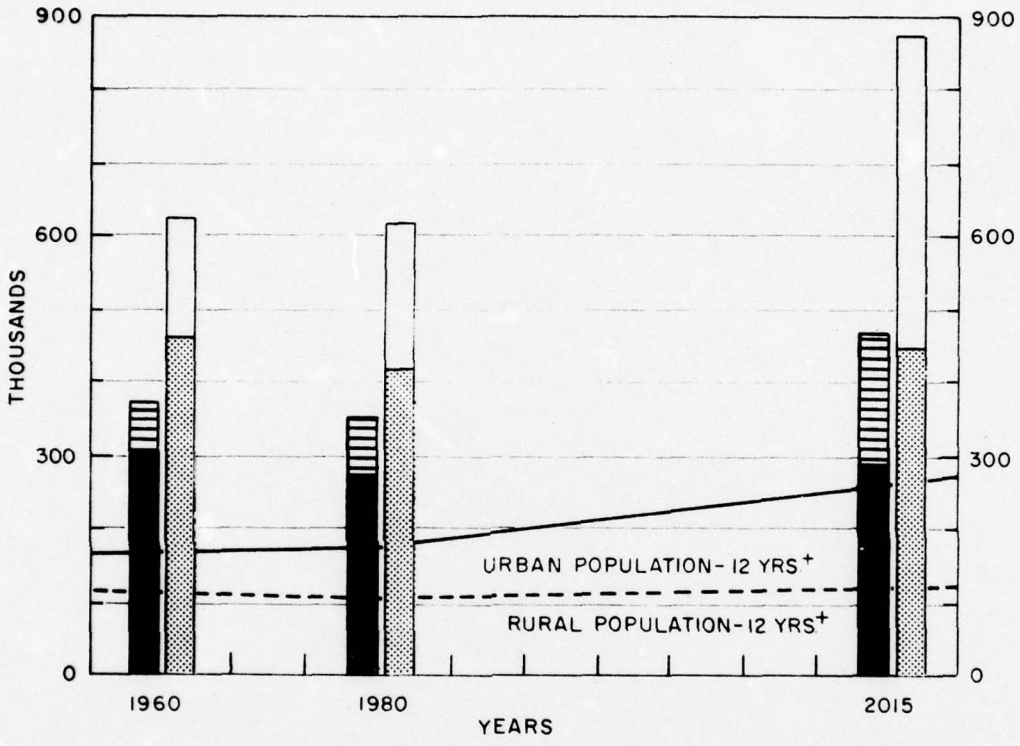
0 10 20 30 40 50 Miles

UNITED STATES DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

Dwg. no. 4-RB-735

PLATE 1

PRESENT AND FUTURE DEMAND FOR FISHING AND HUNTING
BIG BLACK RIVER BASIN



LEGEND

HUNTING DEMAND, MAN-DAYS

URBAN

RURAL

FISHING DEMAND, MAN-DAYS

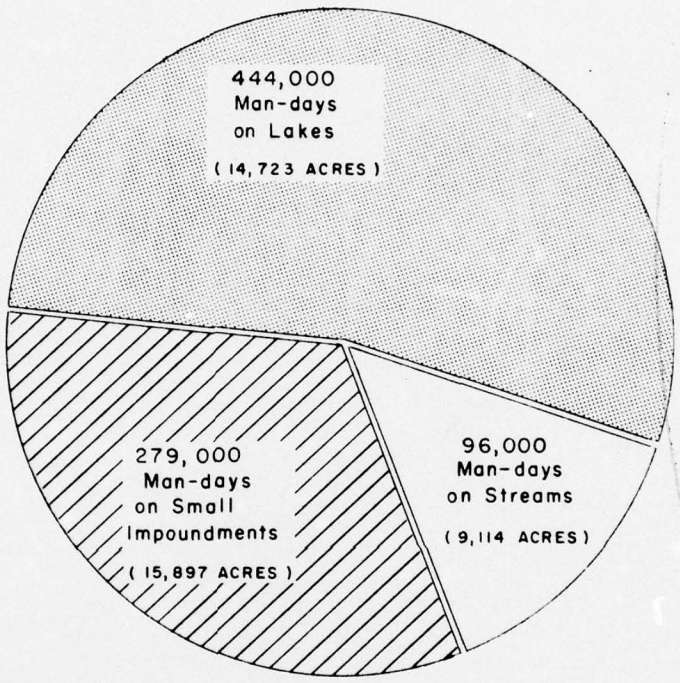
URBAN

RURAL

PLATE 2

PRESENT FISHING SUPPLY

BIG BLACK RIVER BASIN



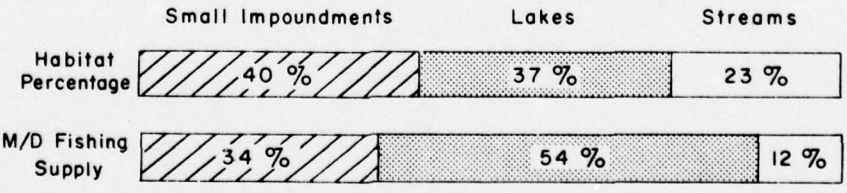
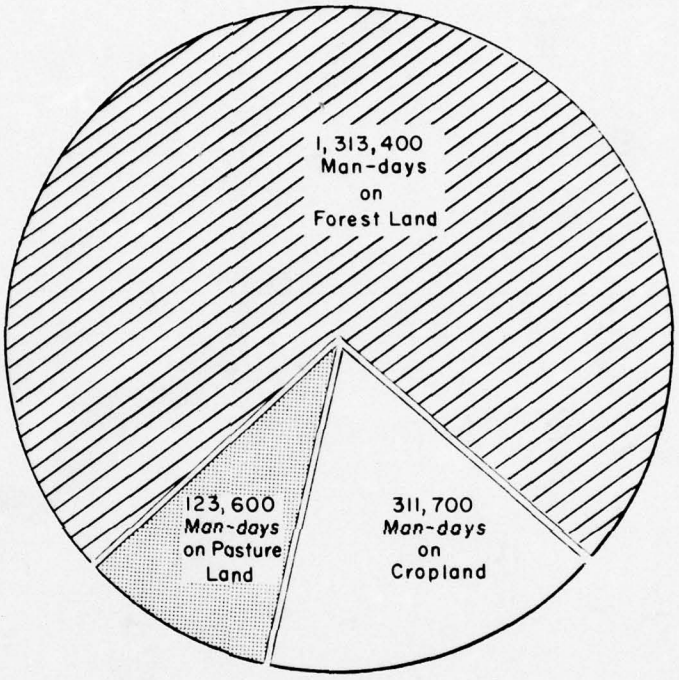


PLATE 3

PRESENT HUNTING SUPPLY

(POTENTIAL LEVEL)

BIG BLACK RIVER BASIN



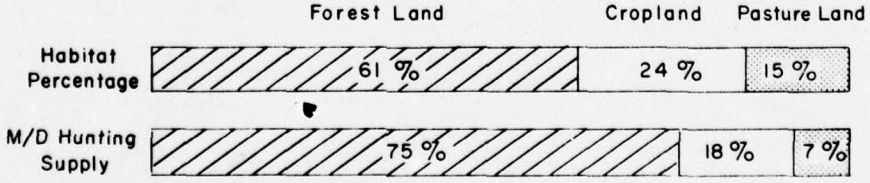


PLATE 4

PROJECTED HABITAT CHANGES
BIG BLACK RIVER BASIN

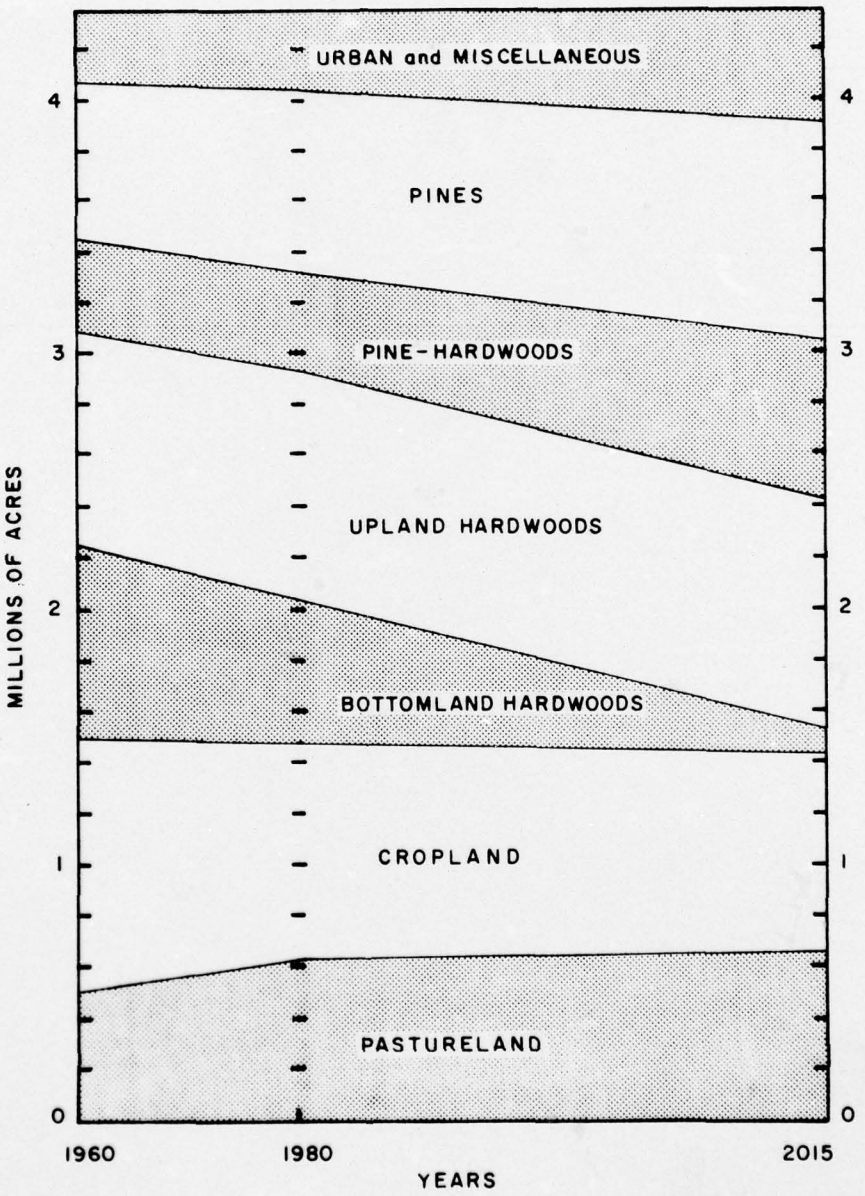


PLATE 5

Game & Fish Commission

STATE OF MISSISSIPPI

PAUL B. JOHNSON
GOVERNOR

BILLY JOE CROSS
EXECUTIVE DIRECTOR

JOHN P. CAMP, JR.
ASST. EXEC. DIRECTOR

P. O. BOX 451 • PHONE 355-9361
Jackson, Mississippi 39205

March 15, 1968

Mr. Richard E. Eichhorn
Field Supervisor
Division of River Basin Studies
Fish and Wildlife Service
315 Peeples-Newman Bldg.
Vicksburg, Miss. 39180

Dear Mr. Eichhorn:

We have no further comments on the Big Black River Basin review report with text revisions in basic data. This report was sent us on March 9, 1968.

Very truly yours,

Billy Joe Cross

Billy Joe Cross
Executive Director

BJC:pd

CC/ Regional Office, Atlanta, Ga.

BIG BLACK RIVER, MISSISSIPPI
COMPREHENSIVE BASIN STUDY

ANNEX E

Municipal and Industrial
Water Supply and Water Quality Control Study

Prepared by
U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT
SOUTHEAST REGION ATLANTA, GEORGIA

April 1968

AD-A036 819 BIG BLACK RIVER BASIN COORDINATING COMMITTEE VICKSBU--ETC F/G 8/6
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY. VOLUME --ETC(U)
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Abstract

A study of the Big Black Basin discloses that storage of water for water quality control will be required if a proposed expansion of a paper mill at Pickens, Mississippi, materializes. Future water requirements are expected to continue to be met from ground water sources and no storage of water for water supply will be required.

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I. INTRODUCTION

Authority

Following the 1961 report of the select Committee on National Water Resources (1)* and subsequent Executive Branch actions, investigations of the Department of the Army and the Department of Agriculture in the Big Black River Basin were converted to a comprehensive Type II study. Participation of the Department of the Interior, the Department of Commerce, the Federal Power Commission and the Department of Health, Education and Welfare was then established. The study is being coordinated by the Department of the Army through its Corps of Engineers, Vicksburg District.

The Department of Health, Education and Welfare participated in this coordinated study through its Southeastern Comprehensive Water Pollution Control Project (SECWPC Project) which is carrying on studies in the major southeastern river basins. Since the comprehensive water pollution control project for the Lower Mississippi River Basin had not been initiated at the time of the establishment of the Department's participation in this study, the SECWPC Project was enlarged to include the Big Black River Basin which normally would be included in the Lower Mississippi River Basin study.

The water supply portion of this report was prepared in accordance with the Memorandum of Agreement, dated November 4, 1958, between the Department of the Army and the Department of Health, Education and Welfare relative to the Water Supply Act of 1958, as amended (43 U.S.C. 390b). The water quality control aspects are considered under authority

* Figures in parentheses indicate a reference. References are listed in Section X.

of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.). Responsibility for these activities was transferred from the Department of Health, Education and Welfare to the Department of the Interior by Reorganization Plan No. 2 of 1966, effective May 10, 1966.

Purpose and Scope

The purpose of this report is to present, as a part of the comprehensive study of water resource of the Big Black River Basin being coordinated by the Corps of Engineers, Vicksburg District, the following:

1. An appraisal of the quantity and quality of water supplies in the Big Black River Basin,
2. Present and future demands for municipal and industrial water supplies,
3. Present and prospective needs for and values of stream regulation for water pollution control and public health,
4. Minimum stream flows required to maintain the required water quality, and
5. Need for an amount and value of storage for water supplies and stream flow control.

Specifically, those areas of the basin or reaches of the main stem and important tributaries which are, or will be, critical in regard to water requirements or pollution control during the 50-year period from 1965 through 2015 have been identified.

The study area consists of the entire basin of the Big Black River which flows in a southwesterly direction to the Mississippi River

through the central Mississippi counties of Webster, Choctaw, Montgomery, Carroll, Attala, Holmes, Madison, Yazoo, Hinds, Warren and Claiborne.

Acknowledgements

Numerous governmental agencies, Federal, state and municipal, and their officials, along with industries in the Big Black River basin, have cooperated in the study. Acknowledgement is gratefully given for their assistance and advice. Included among these were the following who actively cooperated in the study:

Mississippi State Board of Health, Sanitary
Engineering Division

Mississippi State Game & Fish Commission

U. S. Geological Survey, Jackson, Mississippi

U. S. Army Corps of Engineers, Vicksburg District

Special acknowledgement is given to the Mississippi State Board of Health which made available the facilities and equipment of its sanitary engineering laboratory for the processing of water samples.

II. SUMMARY AND CONCLUSIONS

Summary of Findings

1. The Corps of Engineers, Vicksburg District, is the coordinator of an interagency comprehensive water resources study of the Big Black River Basin. No particular Corps of Engineers projects having water supply or water pollution control aspects have been proposed and the FWPCA, in accordance with the coordinator's request, has studied the water supply and pollution control needs of the basin and has delineated those areas which have immediate requirements or will have future requirements in this respect.

2. The study area consists of the entire basin of the Big Black River in central Mississippi and includes all or parts of Webster, Choctaw, Montgomery, Carroll, Attala, Holmes, Madison, Yazoo, Hinds, Warren and Claiborne counties. The Big Black River rises in Webster County and flows southwesterly to the Mississippi River.

3. The whole-county population of the basin in 1960 was 241,900, excluding East Hinds County. Of this population, 73,000 were urban and 168,900 were rural and rural non-farm. It is estimated that the population dependent on water sources within the basin was 201,400 in 1960.

4. The total ground water used in the basin in 1960 was about 10 mgd and in 1965 about 11 mgd. The use of surface water is negligible. There are 21 municipal systems having an average daily demand of about 3 million gallons and several schools with comparatively large facilities. The only major industrial user, a paper mill at Pickens, obtains water from the municipal supply. Total industrial use in the basin is about 0.4 mgd and is for process water.

5. The overall per capita use of water in the Big Black Basin is about 50 gallons a day. The urban population has a per capita use between 60 and 100 gallons per day.

6. The major sources of waste in the basin are municipalities. Significant discharges are as follows:

Municipality	Receiving Stream	Treatment	Population equivalent discharged
Mathiston	Big Black River	None	150
Durant	Big Black River	None	2,240
Goodman	Big Black River	None	1,000
Kearney Industrial Park	Big Black River	None	400
Winona	Hays Creek	None	3,500
Canton	Bear Creek	Secondary	1,225
Flora	Creek to Big Black	Inadequate septic tank	720
Edwards	Bakers Creek	Inadequate septic tank	720
Bolton	Bakers Creek	Inadequate septic tank	400
Clinton	Bakers Creek	Secondary	500

The towns of Eupora and Pickens which were discharging a total P.E. of 2,300 at the time of the survey by the FWPCA have since installed lagoons for treatment.

7. The only significant organic industrial waste (P.E. 1,000) being discharged during the FWPCA survey was from a paper mill situated at Pickens. This mill is now closed down but indications are that the operation will be resumed. The oil wells located along the Big Black

at Pickens and downstream and on the watershed of Fourteenmile Creek contribute chlorides which reach objectionable concentrations in the tributaries. A metal products plant in the Kearney Industrial Park discharges some plating wastes (copper sulphate) to the Big Black River.

8. The FWPCA survey showed the Big Black River to be comparatively unpolluted. Dissolved oxygen levels were high except in the upper reach where low flows and pooling occurs. Total coliform densities were higher than are generally accepted for water contact sports.

Hays, Bear, Fourteenmile and Bakers Creeks are degraded by municipal wastes. These streams have low summertime flows and often dry up in their upper reaches.

The quality of ground water is variable but water of suitable quality can be obtained as in most localities two or more aquifiers are available. Ground water is generally soft to moderately hard.

Conclusions

1. The population of the basin is projected to be 248,500 by 1980 of which 148,500 will be rural. For 2015 the projection is 379,000 of which 159,600 will be rural. Of the rural population, the greater part will be non-farm and by 2015 the farm population will have shrunk to 23,000. The greater part of the population growth will be in the Jackson and Vicksburg metropolitan centers and the population which will be dependent on the basin's water resources will decline to 187,000 by 2015.

2. Projections to the year 2015 indicate that there will be no need for surface water from resources within the Big Black River

Basin. The growth of population and the major part of the industrial growth is expected to take place in the Vicksburg and Jackson metropolitan areas where water from sources outside the basin is available. The overall use of water for domestic purposes will decline and the basin's water resources are likely to remain underused to 2015. The localized exceptions, towns and cities, will be able to double or triple their withdrawals from ground water without difficulty.

3. There will be no need for storage for water quality control on the main stem with the exception of that which may result from the expansion of the paper industry at Pickens. In the event that this plant expands to a 400 ton pulp mill with a capacity for 50 tons of finished paper per day, the Big Black River would require flow augmentation at times of low flow to maintain a necessary 157 cfs of flow at Pickens. The draft-on-storage required would be 18,500 acre-feet per year if the added flow were to be obtained from an impoundment or impoundments. This flow requirement is based on the premise that the paper plant and all communities upstream of Pickens would provide secondary treatment for their wastes and that a minimum of 4 mg/l of dissolved oxygen is to be maintained below Pickens.

If Hays Creek, Bear Creek, Fourteenmile Creek and Bakers Creek are to be used for fish habitat, a high degree of flow augmentation would be necessary by 2015 on the premise that all wastes would be given treatment providing 90 percent removal of B.O.D. If the prevention of nuisance conditions is the only object, there would still be a necessity for stream flow augmentation as these streams often are dry in the summer and fall except in the lower reaches. As these

creeks have a low potential for fish propagation, the alternative of providing tertiary treatment for all wastes is suggested in lieu of stream flow regulation. Lack of information on flows for these creeks makes it impossible to estimate storage needs for flow augmentation.

4. In the event that water quality control by flow augmentation would be required below Pickens, the benefit of an impoundment project or projects for this purpose, as determined by the least cost alternative, would be $52,000 per year. This alternative is the provision of tertiary treatment for the wastes of a proposed paper and pulp mill.

For the four creeks mentioned above, the first cost of tertiary treatment for the municipal wastes projected for 2015 may be taken as a measure of the benefit of storage for water quality control. These costs are as follows:

Hays Creek	$ 37,800
Bear Creek	100,700
Fourteenmile Creek and Bakers Creek	109,600

III. DESCRIPTION OF STUDY AREA

Location

The Big Black River drains an area of approximately 3,400 square miles in central Mississippi. It rises in Webster County and flows southwesterly for about 270 miles to the Mississippi River, passing through the counties of Choctaw, Montgomery, Carroll, Attala, Holmes, Madison, Yazoo, Hinds, Warren and Claiborne (see location map in back of the report). The mouth of the Big Black River is about 25 miles below Vicksburg and about 410 miles from the mouth of the Mississippi River.

Geography and Topography

The relatively narrow basin is about 155 miles long and has an average width of 22 miles. Numerous small tributaries enter the Big Black River throughout its length at fairly even intervals. The valley of the river, also quite narrow, ranges from one-half to 3½ miles from hill line to hill line with an average width of two miles. The slope of the river bottom varies from 2½ feet per mile above Kilmichael to one foot per mile below. The backwater effect of the Mississippi River during flood stage is felt up to 62 miles from the mouth of the Big Black River --- almost to Bovina.

About 56 percent of the total drainage area is forested, about 23 percent is under cultivation and 14 percent is pasture land. The remaining 7 percent is used for other purposes.

Climate

Annual rainfall over the basin averages 52 inches with runoff averaging about 17 inches. Rainfall is heaviest during January, February and March and the months of least rainfall are August, September and October. The flow in the Big Black River follows this general pattern and there is a wide range of discharge throughout the year.

Temperatures in the basin are moderate, averaging 64°F for the year and 79°F from June to September inclusive.

Principal Communities and Industries

The area --- principally an agricultural and lumbering region --- is sparsely populated. Canton, the largest city in the basin, had a population of 9,707 in 1960. Jackson and Vicksburg, the two major population centers sufficiently near the basin to use its water, are served currently by sources outside the Big Black River Basin.

The area's principal industries include: metal and wood products manufacture, poultry raising and paper making. Five producing oil fields lie wholly or partly within the basin.

Current indications are that the existing paper mill at Pickens will be expanded in the near future into an integrated pulp and paper mill.

IV. PROJECT DESCRIPTION

The Corps of Engineers, after study, has not proposed an impoundment in the Big Black River Basin. The requirements set forth in this report for any area are not those expected to be met by definite projects. Thus, storage for water quality control might be provided from multiple purpose impoundments to be constructed by private interests or by governmental agencies other than the Corps of Engineers.

V. WATER RESOURCES OF THE STUDY AREA

Quantity of Surface Water Available

The Big Black River is an uncontrolled stream with a very wide range of discharge as shown in Table 1. The period of greatest flow is normally in the months of January, February and March during which several overflows occur along the river. The period of lowest flow is usually during the months of August, September and October.

Table 1

HISTORIC STREAM FLOWS

BIG BLACK RIVER

Gauge Location	Drainage Area (Sq. Miles)	Period of Record	Flow (cfs) Max.	Min.	Average
Pickens	1,460	1936-1964	49,400	27	1,811
Bovina	2,810	1936-1964	63,500	65	3,351

In the water years of 1936 through 1964 the average monthly mean flow at Bovina was 7,464 cfs for March with an average monthly mean flow of 334 cfs for October. Flows frequently reached 15,000 to 20,000 cfs in the wet months and flows below 100 cfs often occurred in the month of October.

Based on data for the years 1936-1957 the expected minimum once-in-ten-year flow for seven consecutive days is 38 cfs at Pickens and 74 cfs at Bovina. Exhibit I indicates low flows to be expected for other periods of time and recurrence intervals; Exhibit 2 shows flow duration data.

The Big Black River has numerous relatively small tributaries entering at rather evenly spaced intervals as shown on the Location Map. Important creeks include: Fivemile, Fourteenmile, Bogue Chitto, Panther, Bear, Doaks, Big Cypress, Seneasha, Hays, Poplar, Mulberry, McCurtain, Calabrella, Little Black and Spring. At times, all of these creeks, except Doaks Creek, run dry or nearly dry.

Quality of Surface Water

Data were collected during a three month survey conducted during the period of anticipated minimum flow and critical temperature, August 1 through October 31, 1964. The minimum flow observed during the sampling period was 84 cfs. The parameters of quality measured routinely in the study were dissolved oxygen concentration (D.O.), 5-day biochemical oxygen demand (B.O.D.)., total coliform density (MPN per 100 ml), fecal coliform density (MPN per 100 ml), pH, alkalinity, hardness, chloride concentration, turbidity and temperature. The results of these tests, excluding temperature, from twenty-four stations are shown graphically in Exhibits 3 through 11. A statistical tabulation of the data is given in Appendix II. At selected stations, tests were also made for nitrogenous compounds, phosphates, total residue, iron, manganese, color, trace metals, pesticides and radioactivity. Benthic sampling was performed at five selected locations to ascertain the condition of the river as indicated by biological fauna.

The survey showed the Big Black River to be a stream of good quality with a relatively small amount of pollution which generally does not degrade it. Mean D.O. concentrations were above 6 mg/l (milligrams per liter) at most stations and fell below 4 mg/l only in the reach

between Eupora and Kilmichael. In this area the stream has very low flow during the summer and passes through three channels where pools containing decaying vegetation lower the oxygen content. See Exhibit 3.

The variation in dissolved oxygen occurring over a 24-hour period was studied at Station 270210 (Durant), 270190 (Pickens) and 270070 (Bovina). Results showed a diurnal variation of about 1.7 mg/l D.O. and about 21% in D.O. saturation. This change in D.O. is attributed primarily to the photosynthesis function of algae. The D.O. was found to be at a maximum between 5 p.m. and 6 p.m. and at a minimum between 5 a.m. and 7 a.m.

Mean 5-day B.O.D. concentrations were above 2 mg/l only downstream of Mathiston, in the threaded area of Stewart and below Pickens. At no station on the main stem were mean concentrations over 3.6 mg/l found. Exhibit 4 shows the B.O.D. profile for the main stem of the Big Black River. The generally low B.O.D. values and the near saturation levels of dissolved oxygen indicate conditions quite satisfactory for fish and wildlife.

Microbiological examinations showed that the median density of total coliform bacteria (see Exhibit 5) was 5,000 per 100 ml or above in most reaches and exceeded 10,000 per 100 ml in the headwaters; below the junctions of Hays, Bear and Fourteenmile Creeks; and below the towns of West, Goodman and Pickens. The maximum recommended limit for municipal raw water supply is 5,000 per 100 ml. The fecal coliform density, a parameter of pollution by the fecal wastes of humans and other warm-blooded animals, was also determined (see Exhibit 6). The total coliform and fecal coliform densities together showed that the bacterial pollution

is attributable to the discharge of untreated or partially treated sewage by communities on the main stem and its tributaries. The degree of coliform bacterial contamination in the main stem precludes its use at present for swimming or contact water sports but does not preclude its use for a raw water supply for municipalities or industries, although the waters in their present condition would be considered a poor source for municipal use.

The mean pH values ranged between 6.6 and 7.2 throughout the length of the stream (See Exhibit 7). The alkalinity ranged between 10 and 30 mg/l (See Exhibit 8). The pH and alkalinity values observed are in the range acceptable for most water uses.

From the headwaters to State Highway 16 above Canton the mean total hardness values generally ranged between 15 and 21 mg/l. From this point to station 270080 near Edwards, the mean total hardness ranged between 29 and 45 mg/l. Between Edwards and U. S. Highway 61 the mean total hardness ranged between 54 and 62 mg/l. This hardness, which is due to calcium and magnesium salts, is in a range acceptable for most uses and results in a water generally considered "soft". Exhibit 9 presents data on total hardness.

The concentration of chlorides in the Big Black River showed a mean value under 10 mg/l from the headwaters to Pickens. Below Pickens and the Pickens Oil Field, at State Highway 16, the chlorides concentration increased to a mean of 27 mg/l. Below this point and near the area of the Bentonia Oil Field the chlorides content reached a mean of 35 mg/l. From this point to U. S. Highway 61 mean value ranged between 27 mg/l and 35 mg/l. Maximum chloride content observed in the

river was 97 mg/l at State Highway 16. Such concentrations (See Exhibit 10) are well below the 250 mg/l recommended limits for drinking water supplies but are marginal for selected industrial uses. A high chlorides content was observed at Station 270040 on Fourteenmile Creek near its confluence with the Big Black River. This was due to pollution from the Bolton Oil Field. In the summer, when flows are very low, the chloride concentration becomes high due to inadequate dilution of the seepage and overflow from brine holding pits. During the survey a maximum value of 305 mg/l and a mean of 71 mg/l were recorded on this creek.

During the survey period the Big Black River showed a mean turbidity ranging from about 30 Jackson units in the area near Stewart where pooling occurred to slightly over 200 at State Highway 16 and U. S. Highway 20. In the winter months, at times of high runoff, the turbidity is considerably greater. Turbidities observed (See Exhibit 11) do not preclude the use of the waters for most industrial use or for the raw supply for municipal systems, however, such turbidities tend to reduce fish production (2).

Observations were made at selected stations for nitrogen and phosphorus compounds. At Station 270220 (West) the total content of ammonia, nitrites and nitrates, expressed as nitrogen, ranged from 0.180 mg/l to 4.40 mg/l. At Station 270080 (Interstate Highway 20), the range was from 0.09 to 5.60 mg/l. Averages at Stations 270220 and 270080 were 1.347 and 1.649 mg/l respectively. Total phosphates ranged from 0.08 to 0.40 mg/l at Station 270220 and 0.028 to 0.35 mg/l at Station 270080. Averages at Stations 270220 and 270080 for phosphates were 0.26 and 0.168 mg/l respectively.

The total nitrogen concentrations were not in amounts which would limit the water uses of the main stem for most beneficial uses. The maximum phosphate concentration observed was just below that which can adversely affect waters to be treated for municipal supplies. The observed concentrations of nutrients are conducive to algal growths and if the higher concentrations persisted for long periods nuisance conditions would arise. Algae were observed on the main stem throughout its length during the study but at no time did the growths reach nuisance levels. The cause of such high nutrient concentrations appears to be both land runoff and the presence of raw and treated sewage discharges into the stream. Hays Creek, which receives raw sewage, and Bear Creek, which receives the effluent from sewage stabilization lagoons, both showed much higher average nutrient concentrations and large algal growths were observed in them.

Dissolved solids in the main stem in low flow periods were found to be below the concentrations which would be detrimental to the majority of water uses.

Total iron and manganese in the main stem were found in concentrations as high as 3.6 mg/l and 0.3 mg/l respectively. These concentrations may cause difficulties should these waters be used for municipal supplies or some industrial uses.

During the survey color ranged between 20 and 50 platinum-cobalt units but it is known that in the lower reaches color has been observed at up to 200 units. For most purposes the color would be acceptable.

Results of tests for trace elements indicated no significant concentrations and gross radiological measurements indicated radioactivity

was completely within the range considered harmless in the U. S. Department of Health, Education and Welfare, 1962 "Drinking Water Standards".

A pesticides analysis showed only traces of endrin and dieldrin, two common agricultural chemicals. To this date agricultural chemicals have not been a major source of pollution in the Big Black River. There are, however, indications that pesticides, nitrates, phosphates and other chemicals associated with agriculture will eventually be a problem. Other studies in the Big Black River Basin coupled with concurrent research should lead to a better understanding of this problem in the future.

Biological assessment of water quality was made from results of dredge collections of bottom-dwelling benthic invertebrates taken at five selected stations on the river during the months of April, June, October and December, 1965. (See Exhibit 16 for location of stations and Exhibit 12 for presentation of benthic sampling results.) At all stations, the populations were quite dense as shown by the relatively high mean numbers of organisms per square foot. The capacity of these habitats to support well-balanced communities of invertebrates is indicated by the large number of different species present at each station. Species known to be sensitive to pollution, such as mayfly nymphs, caddisfly larvae, and unionid clams, were found at each of the stations. Consequently, it is concluded that the water is of good biological quality and that no serious pollutional damage to aquatic life is occurring at the stations studied during the 1965 survey.

Hays Creek, Bear Creek and Fourteenmile Creek were found to be degraded. The sanitary quality of these streams is very poor due to

the volume of domestic wastes, treated and untreated, discharged into them. High concentrations of chlorides were observed in Fourteenmile Creek. These streams have very low flows at times and with the constant waste loadings their quality is subject to great fluctuation.

Quantity of Ground Water Available

The Big Black River Basin is underlain by several thousand feet of clay, silt, sand, gravel, and limestone. This sedimentary material is mostly loose to semi-consolidated and is stratified. The beds dip to the southwest at the rate of 20 to 50 feet per mile. The Big Black River flows to the southwest but at a lower gradient, and therefore any specific formation is at a greater depth below the river the farther one goes down the river. The formations crop out at the surface in belts which generally are perpendicular to the flow of the Big Black River.

Most of the available ground water in the basin is contained in six of the most permeable beds of the stratigraphic section underlying the basin. These more prolific water bearing zones range in thickness from about 100 feet to about 1,000 feet. The aquifers overlap to the extent that a well drilled to the base of fresh water will in most places penetrate two or more aquifers.

Practically all of the water used in the basin is ground water; a limited amount of surface water being used for supplemental irrigation of row crops. Well depths range from less than 20 to more than 2,400 feet, depending on geology, and wells producing 500 to 1,000 gpm of water are common in the basin. Most of the area is underlain by an aquifer or aquifers from which a properly constructed well would produce as much as 2,000 gpm. Probably the least productive combination of

aquifers is to be found in the Ackerman-Eupora-Kilmichael-McCool area and in the area near the mouth of the Big Black River. However, none of the towns in the area should experience any real difficulty in doubling or tripling their ground water pumpage.

Quality of Ground Water

Quality of the water is variable, but generally water of suitable quality for most needs can be obtained. At most localities two or more aquifers, each of which contains water of different quality, are available. Southwestward (down the dip) within an aquifer the water contains more dissolved solids. Also, generally the deeper a well at a site, the higher will be the dissolved solids content of the water. Shallow ground water (less than 200 feet deep) in the basin usually contains about 100 mg/l of dissolved solids. Most ground water in the basin from more than 2,500 feet below land surface contains more than 1,000 mg/l of dissolved solids. Several areas have deeper fresh water, but near the mouth of the Big Black River, brackish water is found much more shallow than 2,500 feet. There the base of the fresh water is only about 300 feet below land surface.

The sources of ground water in the Big Black River Basin are the Wilcox Group, Sparta Sand, Cockfield Formation and the Catahoula Sandstone.

Water from the Wilcox Group is generally soft, becoming harder as the formation dips southwestward. Color is a problem in the lower portion of the dip. The water is of the sodium bicarbonate-calcium bicarbonate type.

The Sparta and Cockfield formations yield a soft, sodium bicarbonate water except at the top of the Cockfield where there is increased hardness. Iron is a problem in some places reaching 3.5 mg/l in the upper part of the Cockfield. In the lower end of the dips these waters have color due to lignite.

The Catahoula Sand yields soft to moderately hard water which is generally clear but sometimes high in iron content.

In general, the ground water quality in the basin is satisfactory for most uses.

VI. THE ECONOMY

General

According to the "Economic Base Study of the Pascagoula, Pearl and Big Black River Basins Study Area", (hereinafter referred to as the Economic Base Study), "The Big Black River Basin is characterized by a predominantly rural, sparsely populated economy. Its growth has been and is expected to continue to be affected by lack of employment opportunities encountered in the gradual changeover from an agricultural to a diversified economy." (3)

"However, the influences of the Western portion of Hinds County and Warren County are projected to check past economic declines before 1980. After a drop to 235,400 in 1965, population projections show an expected reversal to 248,000 by 1980 and a further increase to 379,000 by 2015. The same general trend is reflected in households, labor force and employment during this projection period."

The following table, taken from the Economic Base Study summarizes the above statements.

Table 2

SUMMARY OF PROJECTIONS OF MAJOR ECONOMIC INDICATORS FOR THE BIG BLACK RIVER DRAINAGE BASIN

	1960	1965	1980	2015
Population (thousands)	241.9	235.4	248.5	379.0
No. of households (thousands)	63.7	62.6	68.6	111.5
Labor force (thousands)	80.3	77.3	81.9	124.9
Employment (thousands)	74.2	70.2	72.1	109.2
Personal income (Millions of 1962 dollars)	275.5	311.8	430.1	1,088.7
Per capita income (1962 dollars)	1,139	1,325	1,731	2,873

On a whole-county basis, with the exception of Hinds County which was split because of its exceptionally heavy population concentration in the Pearl River portion, the Big Black River basin is comprised of ten Mississippi counties plus the Western portion of Hinds County. The ten whole counties are as follows: (1) Attala, (2) Carroll, (3) Choctaw, (4) Claiborne, (5) Holmes, (6) Madison, (7) Montgomery, (8) Warren, (9) Webster, and (10) Yazoo.

As indicated by the preceding statement, and again quoting from the Economic Base Study, "The economy of the basin is dominated by small, noncommercial farms. Cotton and cattle account for over 90 percent of the value of farm products sold."

Both of the major population centers sufficiently near the basin to use its waters, Jackson and Vicksburg, are currently served by sources outside the Big Black River basin and this will at least largely remain true for the next 50 years or more. Vicksburg obtains its water supply from the Mississippi River and discharges its wastes back into the Mississippi. Jackson currently uses the Pearl River for both uses and it appears unlikely that any appreciable use will be made of water from the Big Black River basin in the future by that city. There are no population centers of appreciable size (over 5,000) located on the main stem of the Big Black and only one city (Canton) of this size in the basin. Furthermore there are few population centers of this size near the basin.

According to the Economic Base Study, "The Big Black Basin has been second only to the Northwest Mississippi Basin* in a preponderance of rural population. In 1930, those people residing in the Basin's rural areas comprised 85 percent of its total population. Despite a severe decline in rural population from 232,300 in 1930 to 168,900 in 1960, 70 percent of the Basin's population remained in the rural category in 1960." Table 3 prepared from data given in the Economic Base Study, portrays the movement of the major population components during the past and as estimated for the future.

Table 3

PAST, CURRENT AND PROJECTED POPULATION OF THE BIG BLACK RIVER BASIN BY MAJOR POPULATION COMPONENTS
(population in thousands)

Population Component	Year 1930	1940	1950	1960	1965	1980	2015
Total:	274.0	298.9	266.4	241.9	235.4	248.5	379.0
Urban	41.7	52.7	61.0	73.0	78.1	100.0	219.4
Rural:	232.3	246.1	205.3	168.9	157.3	148.5	159.6
Nonfarm	36.4	43.9	60.0	97.5	105.3	117.8	136.6
Farm	195.9	202.2	145.3	71.4	52.0	30.7	23.0

* The Economic Base Study covers seven basins in Mississippi, Alabama and Louisiana. One of these is the Northwest Mississippi Basin which consists of the Yazoo Delta and the Yazoo Hills area of Yazoo River basin in Mississippi.

Both the urban and rural-nonfarm populations showed considerable and continuous growth during the 1930 to 1960 period while the rural-farm population showed a severe and continuous decline except during the 1930 to 1940 period when an increase was experienced (attributed by the Economic Base Study to conditions created by World War II).

Assuming the Economic Base Study's statement that "The expected growth in urban population in the basin from 1960 to 2015 will be tantamount to the increase in urban population in the Vicksburg urbanized area and that portion of the Jackson urbanized area lying within the basin's boundary" to hold reasonably true for the future domestic water needs from the Big Black River basin are obviously likely to be comparatively small to the year 2015 (see previous statement on sources of water for Vicksburg and Jackson).

Number and type of households provide some measure or indication of domestic water needs. The following statement from the Economic Base Study is indicative of their findings and conclusions in this area: "Continued out-migration of family-farming age groups from the Big Black Basin during the 1940 to 1960 period caused an absolute decline in the number of households by almost 12,000. In fact, the basin contained more households in 1930 than in 1960--67,100 in contrast to 63,700 . . . . It should be 1980--when households are projected at 68,600--before the number of households again approaches the 1950 level of 69,400." Again, however, the Study states, "the overflow of Jackson's residential areas into

the basin should then become a large factor in the basin's rise in number of households," indicating that much of the domestic need for water accounted for by households, per se, will likely come from outside the basin's drainage area. This same reasoning applies even more explicitly to the Vicksburg area in Warren County where water from the closest sources, the Mississippi River or ground water, is comparatively cheap and plentiful. If the Jackson Standard Metropolitan Statistical Area (SMSA) population "spillover" into the basin and the Vicksburg influence is taken into account, the projected number of households relying on the Big Black River basin drainage area to meet their water needs is considerably smaller than those in existence in 1950 and only slightly greater than in 1960. Our estimate places the approximate number of households actually depending on water from the Big Black River Basin at 59,000 in 1950; 53,000 in 1960; and only 55,000 by 2015 which amounts to a population of about 226,600 in 1950; 201,400 in 1960; and 187,000 by 2015, or a continuous decline in the number of people dependent upon the waters of the basin.

Industry

Despite the rapid decline in the rural-farm population, agriculture is still expected to continue to be the major water-use industry using water from the Big Black River Basin under current assumptions. Estimates from an agricultural chemicals study being conducted by Mississippi State University under a contract with the FWPCA relative to expected agricultural pollutants in the basin have not as yet been completed.*

* A "Special Agricultural Studies Contract" with Mississippi State University, Department of Agricultural Economics.

A cursory examination of the Economic Base Study might lead one to the conclusion that the manufacturing industry is projected to become the most important user of water from the Big Black River Basin. This, of course, could happen but is not indicated after close and detailed analyses of the Economic Base Study projections. Even though total manufacturing employment, by place of work, is shown to have grown from 4,300 to 10,700 between 1930 and 1960 and is projected to increase to 31,400 by 2015 and employment in the "major water-use industry groups" has increased from 379 employees in 1930 to 1,847 in 1960 and is projected to increase to 7,030 by 2015, examination of information available indicates that most of this employment is located in plants situated in or near Vicksburg and Jackson. In the case of these plants, withdrawal needs for water will almost assuredly be met from the ground water or the Mississippi and Pearl Rivers, respectively. In the case of plants located in West Hinds County near Jackson, wastes will likely be discharged into nearby tributaries of the Big Black River, but plants in or near Vicksburg are expected to continue discharging their wastes into the Mississippi River.

Analysis of industrial employment reported by the 1964 Mississippi Manufacturers Directory (4) for cities, towns, and villages actually located within the Big Black River Basin and likely to discharge municipal or industrial effluent into the river or its tributaries, and of employment reported by a 1965 Public Health Service survey of industrial waste sources of the Big Black River

basin shows that, comparatively speaking, very few water-use industries are currently located within the Big Black River area. Utilizing growth rates for Standard Industrial Classification (SIC) two- and four-digit industry groups indicated by the Economic Base Study for the Big Black River Basin, and current estimates of major water-use industry types (both withdrawal and in-place or polluting type users) developed as indicated above, the following estimates (Tabel 4) of current and future manufacturing employment by the water-using industries dependent upon use of water within the Big Black River Basin have been made:

Table 4

CURRENT AND FUTURE MANUFACTURING EMPLOYMENT BY THE WATER-USING INDUSTRIES IN THE BIG BLACK BASIN

SIC Code	Brief Name of Product Name	Employment (no. of employees) Current 1964-1965	Projected 1980-2015	
2015	Poultry	150	280	420
2026	Fluid milk	40	70	110
2086	Soft drinks	30	40	90
2097	Manufactured ice	10	20	30
2491	Wood preserving	30	20	30
2621	Paper mill	60	80	140
2812 (19 and 99)	Alkalies (and other chems.)	40	60	150
2872	Fertilizers	60	90	220
2879	Pesticides, agricultural	10	10	30
3461 (and 71)	Metal stampings (and plating)	200	280	640
	Total	630	950	1,860

Because the Base Study growth rates were heavily weighted with growth influences from Jackson and Vicksburg, it is reasonable to suspect that the preceding projections may be optimistic,

particularly with regard to those industries which commonly tend to locate in or near large population centers or whose growth tends to be dependent upon the growth of local population, whether in or near a large or small center.

In brief, it appears that, comparatively speaking, the water resources of the Big Black River basin are currently greatly underused and are likely to remain so throughout the future period under consideration for purposes of this study (to the year 2015). It is expected that there will be localized exceptions to this generalized observation.

The most highly industrialized center dependent upon the Big Black River basin water resources as well as the largest and fastest growing (outside of the satellite towns of Jackson located in West Hinds County and influenced by the growth of Jackson) is Canton in Madison County. It now uses deep wells for its water supply and disposes of both its municipal and industrial wastes into comparatively small streams tributary to the Big Black River.

Pickens is a small, and thus far at least, slow growing town located in Holmes County on the Big Black River main stem. It is the site of a small paper mill, the only one in the basin. There are indications that this plant will be expanded and that a pulp mill (SIC four-digit code 2611) will be installed and integrated with it. The expected requirement of 26 mgd of water will be supplied from wells. The pulp mill would be capable of

producing 400 tons of pulp per day and the paper mill 50 tons a day. A mill of this size can currently be expected to provide direct employment for about 200 people on a full-time basis during an average year and indirect employment for 600 more people is indicated.

VII. WATER REQUIREMENTS

Present Municipal and Industrial Requirements

Surface water is not used in any appreciable quantity within the basin, the main use being for supplemental irrigation of row crops. There are 21 municipalities plus a number of schools which have water systems supplied by deep wells. The majority of the wells require no treatment or chlorination only. A small number of industrial plants have their own deep wells for water supply, but the majority secure their water from municipal sources. The major industrial water users are: a poultry plant at Canton (0.080 mgd), a metal products plant at Flora (0.020 mgd for cooling), a dairy products plant at Canton (0.040 mgd wash water) and a paper mill at Pickens (presently using only small quantities of water). Agriculture uses some water for irrigation but the quantity is distributed throughout the basin and has no major effect on any given portion of the basin. A complete tabulation of municipal water supply systems in the basin is listed in Exhibit 13. The ground water supply is more than ample at the present rate of withdrawal.

Future Municipal and Industrial Water Requirements

From the Economic Base Study, the future growth of the basin will be concentrated largely in the Vicksburg and Jackson SMSA's. Both of these cities have ample water supply for the future, Vicksburg from the Mississippi River or an abundant ground water supply and Jackson from the Pearl River Reservoir. As previously

stated, none of the towns in the area should experience any difficulty in doubling or tripling their ground water pumpage which would provide quantities in excess of anticipated needs during the study period.

Along the main stem of the Big Black River, there are no indications through year 2015 that surface water will be required by either municipalities or industry.

VIII. WATER QUALITY CONTROL

General

Surface waters in the Big Black River Basin are used for fish and game propagation, a small commercial fishery, stock watering, recreation and the disposal of municipal and industrial wastes. No use of surface waters is made for municipal or industrial water supply and their use for irrigation is insignificant. It is expected that both domestic and industrial demands on the river for water supply will be minimal through the year 2015.

An important current use for the river and its tributaries is for sport fishing. The U.S. Fish and Wildlife service estimated the demand for this sport in the whole basin for 1965 at 606,000 man-days (5). The expected demand for the year 2015 is 873,000 man-days. The present capacity of the basin is 750,000 man-days per year. Although only 18% of the basin's capacity lies in the main stem and its tributaries (the greater portion is on small impoundments and lakes), the expected deficit would result in pressure on these. The supply of fishing habitat is not expected to greatly increase in future years except in the construction of private ponds, small watershed developments and other impoundments.

A small commercial fishery now exists but does not use the basin's capacity for this activity. According to the Fish and Wildlife Service, this resource offers an opportunity for development.

The Big Black River is inaccessible for a great part of its length and for this reason its full potential for recreation is presently not realized. The Bureau of Outdoor Recreation states that the con-

struction of access roads to the river will increase its use for recreation. The greatest potential for recreation is, however, below U.S. Highway 80 (I20) where the channel is clearer and the flow more constant. To develop recreation above this point, impoundments on the main stem would be needed. For the basin as a whole, small Soil Conservation Service and private impoundments offer the greatest possibility for recreation.

Present Sources of Pollution

The major sources of pollution in the Big Black River Basin are municipalities and a small number of industries. Exhibits 14 and 15 list the known sources of waste. Figures 1 and 2 show the location of these sources.

It will be noted that the municipalities of Winona, Durant and Goodman are significant sources of pollution from raw sewage. Other municipalities discharge wastes after providing various degrees of treatment. The town of Pickens discharged raw sewage at the time of the water quality survey but has since installed treatment facilities. The town of Bentonia, which did not discharge wastes at the time of the survey, now has a sewer system and sewage treatment facilities and discharges a waste with a P.E. of about 50.

A plant in the Kearney Industrial Park near Flora discharges inorganic plating wastes into the Big Black River. At Pickens, a paper making plant now closed down, was discharging a waste with a P.E. of 1,000. Two creosoting plants, one at Stewart and the other at Learned are intermittent sources of wastes of unknown strength.

FIGURE 1

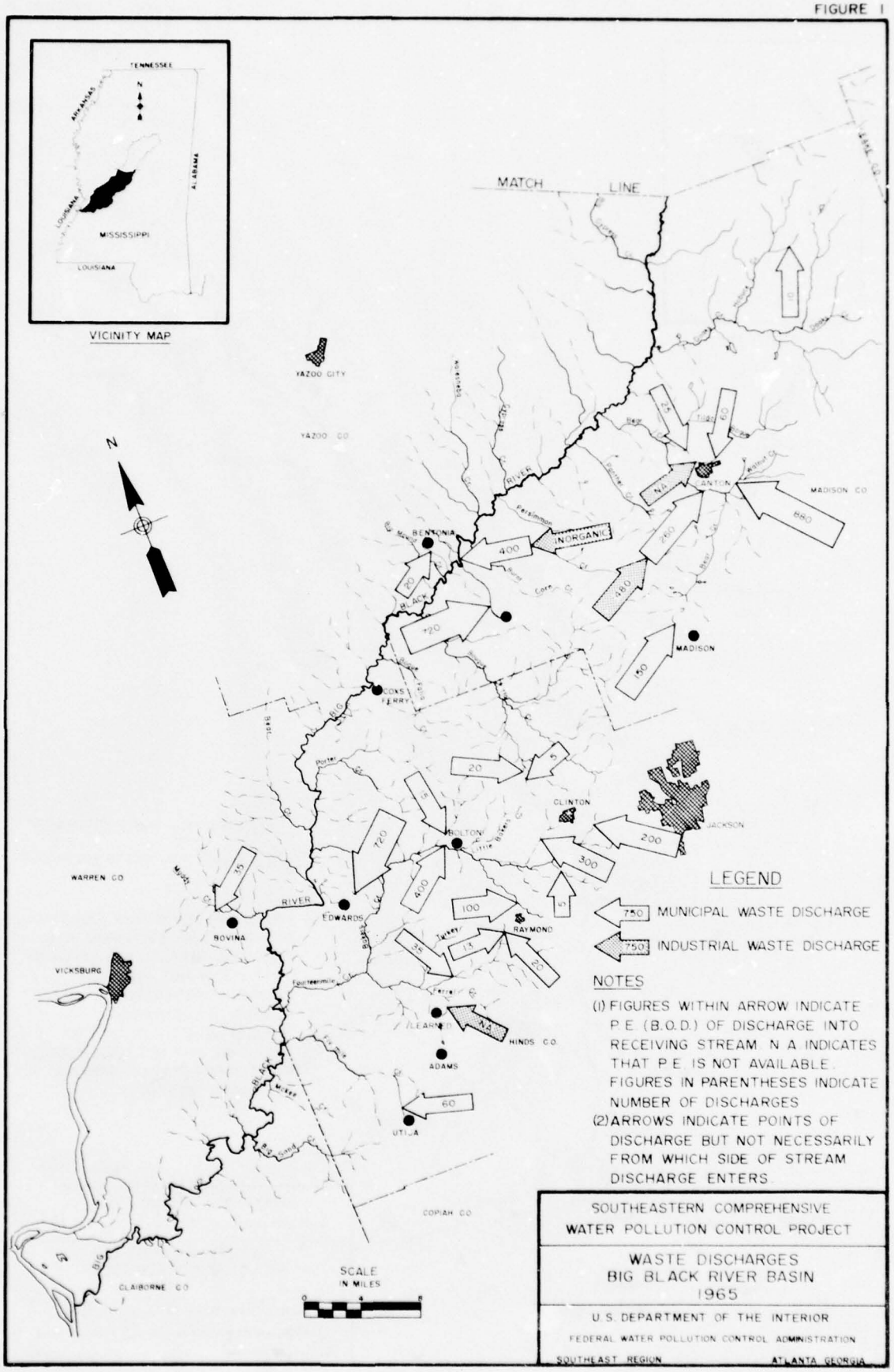
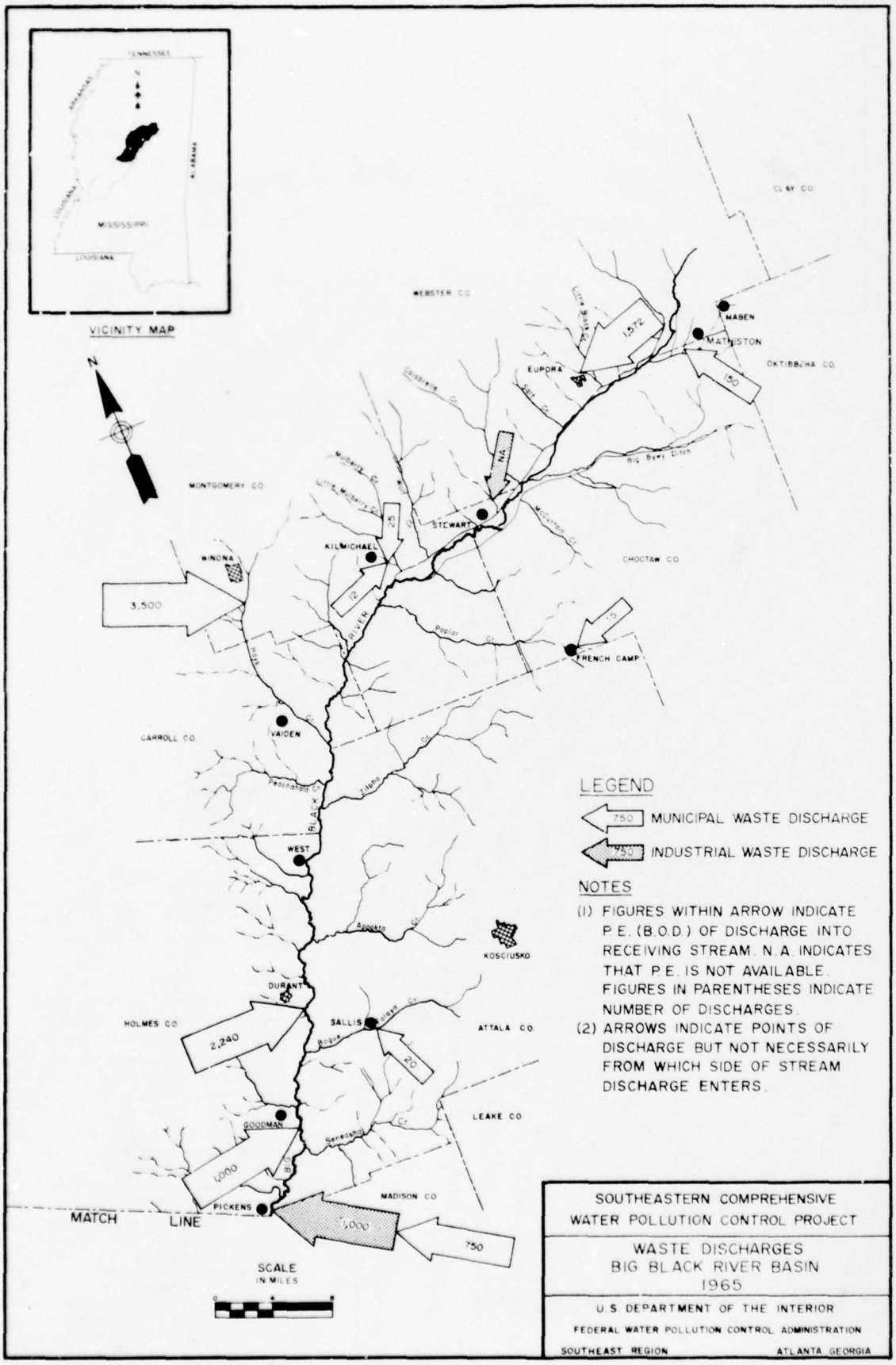

TENNESSEE
ARKANSAS
LOUISIANA
MISSISSIPPI
ALABAMA
LOUISIANA
VICINITY MAP
MATCH LINE
YAZOO CITY
YAZOO CO.
MADISON CO.
BENTONIA
INORGANIC
CANTON
MADISON
CONST FERRY
CLINTON
JACKSON
BOLTON
WARREN CO.
EDWARDS
BOVINA
RAYMOND
VICKSBURG
HINDS CO.
ADAMS
UTICA
COPIAH CO.
CLAIBORNE CO.
BIG BLACK RIVER
SCALE IN MILES
LEGEND
MUNICIPAL WASTE DISCHARGE
INDUSTRIAL WASTE DISCHARGE
NOTES
(1) FIGURES WITHIN ARROW INDICATE P.E. (B.O.D.) OF DISCHARGE INTO RECEIVING STREAM. N.A. INDICATES THAT P.E. IS NOT AVAILABLE. FIGURES IN PARENTHESES INDICATE NUMBER OF DISCHARGES
(2) ARROWS INDICATE POINTS OF DISCHARGE BUT NOT NECESSARILY FROM WHICH SIDE OF STREAM DISCHARGE ENTERS.
SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT
WASTE DISCHARGES BIG BLACK RIVER BASIN 1965
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA, GEORGIA

FIGURE 2



LEGEND

750 MUNICIPAL WASTE DISCHARGE

750 INDUSTRIAL WASTE DISCHARGE

NOTES

(1) FIGURES WITHIN ARROW INDICATE P.E. (B.O.D.) OF DISCHARGE INTO RECEIVING STREAM. N.A. INDICATES THAT P.E. IS NOT AVAILABLE. FIGURES IN PARENTHESES INDICATE NUMBER OF DISCHARGES.

(2) ARROWS INDICATE POINTS OF DISCHARGE BUT NOT NECESSARILY FROM WHICH SIDE OF STREAM DISCHARGE ENTERS.

SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT

WASTE DISCHARGES
BIG BLACK RIVER BASIN
1965

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION ATLANTA, GEORGIA

At Edwards, a large egg producing plant routinely disposes of waste by application to land which apparently does not affect the water courses in the area. This plant has, however, on occasion caused local pollution in water courses due to poor housekeeping.

In the basin there are seven oil fields, two of which have been abandoned. The producing fields, with their production of oil and water, are as follows:

Field	Producing Wells	1964 Production in barrels (6) Oil	Water
Pickens	24	214,746	3,223,575
Bentonia	12	349,564	269,180
Flora	7	91,385	61,213
Bolton	46	1,188,188	911,814
Tinsley	16 (in basin)	173,000 (est.)	1,600,000 (est.)

The Pickens field lies across the Big Black River at about mile 157, about 6 miles downstream of Pickens. It is the oldest of the fields in the basin and has the characteristic of producing a large volume of brine per barrel of oil (15 to 1). This field practices disposal of brines in open earth pits. The fact that brines escape in one way or another to the main stem of the Big Black River is borne out by the rise in average content of chlorides at State Highway 16 (Station 270170).

The Bentonia field, situated along the right bank of the Big Black River at about mile 119, is a newer field and produces less than one (0.77) barrel of brine per barrel of oil. Across the river and several miles southward of the Bentonia Field is the Flora Field.

This field is not directly along the river but is on Burnt Corn Creek which enters the Big Black River at about mile 112. The Flora Field also produces less than one barrel (0.67) of brine per barrel of oil. The field has at least one salt water disposal well but earthen pits are used. Burnt Corn Creek has been at times highly polluted with brine.

The Tinsley Field is located about 6 miles northwest of Bentonia. Of its 246 producing wells, only 16 appear to be in the Big Black River Basin. An estimated production of oil and brine for these is shown in the table. Along with these wells there are three brine disposal wells. Pits are used for the others. The area is in the headwaters of Mound Creek which enters the Big Black River at about mile 110. Mound Creek in its upper reaches is intermittent and it is not known whether wastes from the Tinsley Field reach it and thence reach the Big Black River. The Mississippi State Game and Fish Commission has reported no trouble from the Tinsley Field.

The Bolton Field is situated between the towns of Bolton and Edwards in the watershed of Bakers Creek, a tributary of Fourteenmile Creek. Fourteenmile Creek enters the Big Black River at about mile 53. This field, with 46 wells producing brine at a rate of 0.77 barrel per barrel of oil, is the source of high chlorides content in that creek. The Bolton Field has at least one salt water disposal well.

By state law, oil field brines are to be disposed of by 1) injection to the stratum from which produced or other proven salt water bearing strata, 2) by disposal in earthen pits or the like having no outlets, or by 3) disposal to streams and bodies of water where no detrimental effects are caused. Oil wastes are to be disposed of in

such a way that they do not "cause pollution" of surface waters. The common holding pond for brine and oil wastes has been a source of pollution in the basin and in the recent past the State Game and Fish Commission has imposed fines upon oil field operators for releases of these wastes into waters of the Big Black basin.

The present pollutional load on the main stem of the Big Black River does not create any problem except one of bacterial contamination.

The upper reaches of the tributaries of the Big Black, with the exception of Doaks Creek, run dry much of the time in the period May through October. At such times, the wastes of Winona cause nuisance conditions to exist in Hays Creek.

Future Waste Discharges

As set forth in the section on economics, the projected growth in the urban population of the basin will be in the Vicksburg and Jackson urbanized areas lying on the basin's edge. This population would be expected to be served by the sewerage systems of these metropolitan centers and only a part of the waste from it may reach the Big Black River system. The population within the basin, on the Big Black River and its tributaries, is expected to decline from the 1960 figure of 201,400 to 187,000 by 2015. The construction of treatment facilities by several towns now without them and the replacement of several inadequate facilities will result in a future waste load that is smaller than the present one on the main stem.

The Economic Base Study indicates that although there will be an increase in the employment in industry in the basin's population, most of this employment will be in the Vicksburg and Jackson areas.

The projected increase in employment in water using industry, heavily weighted by the growth influences of the metropolitan centers, would be from 630 to 950 by 1980 and to 1,860 by 2015. The additional wastes, after treatment, excepting those from a possible expansion of a paper making plant, would be assimilated by the river.

The exception referred to above is the possibility of the resumption of operation of the paper making plant at Pickens and its being enlarged to produce 50 tons of paper and 400 tons of pulp per day. Such an enlargement would be expected to increase the waste load at Pickens to a magnitude that would necessitate a high degree of treatment plus low stream flow control to avoid adverse conditions downstream.

The future municipal loads from communities situated on tributaries which have low flows or no flow for part of the year may cause nuisances on these streams. Those creeks which would be affected are Hays, Bear, Fourteenmile and Bakers.

Water Quality Criteria

The principal future use of the waters of the Big Black River Basin will be for fishing and recreation. For the propagation of fish the minimum level usually recommended for dissolved oxygen is 4 mg/l. For contact water sports the generally accepted limit for total coliforms is the MPN of 1,000 per 100 ml. Experience has shown that streams in the Gulf Coastal region may show total coliform densities greater than this in the apparent absence of pollution. This criteria for the sanitary quality of streams in this region merits further study.

Water Quality Control

As mentioned earlier in this section, the Big Black River has sufficient assimilative capacity for the waste loads projected to 2015 with the exception of that which may arise from an expansion of the paper industry at Pickens.

In 1965 there were indications that the present mill at Pickens would be expanded to produce 400 tons of bleached pulp and 50 tons of paper per day. A pulping mill smaller than 400 tons per day is usually considered to be economically infeasible.

Based on the expected 7-day, once-in-ten-years low flow of 38 cfs at Pickens, the minimum flows required for two combinations of bleached pulp and paper production at that point would be:

Mill capacity	Minimum flow required at 32°C	Draft-on-storage (acre ft/yr)
400 tons pulp 50 tons paper	157 cfs	18,500
600 tons pulp 75 tons paper	253 cfs	39,700

The calculations for the required flows take into consideration the future treated waste loads of Pickens and upstream communities, the requirement of 4 mg/l of dissolved oxygen below Pickens, and an 85% reduction of the paper mill waste prior to discharge to the river. The assumption is made that the required additional flow would be from releases from one or more impoundments.

If it is desired to maintain in Hays Creek, Bear Creek, Fourteenmile Creek and Bakers Creek waters of a quality suitable as

a habitat for fish, the following minimum flows would be required at the points indicated:

Stream	Minimum flow
Hays Creek	2.4 cfs below Winona
Bear Creek	20.8 cfs below Canton
Fourteenmile Creek	0.2 cfs below Raymond
Bakers Creek	0.5 cfs below Raymond
	3.6 cfs below Bolton
	2.7 cfs below Clinton
	4.6 cfs below Edwards

These flows are those which would be required to assimilate wastes expected by the year 2015 after such wastes have been given secondary treatment providing the removal of at least 90 percent of the B.O.D. The Fish and Wildlife Service states that these streams have little potential for fish habitat. If it is decided that they are not to be used for this purpose, these effluents would require augmentation by one-third of the flows given above to prevent the occurrence of nuisance conditions.

The alternate of using the upper reaches for the transport of well-treated effluents during dry weather might be considered. To prevent nuisance conditions, the wastes would require tertiary treatment during periods of low stream flow.

The fact that there are no records for flows on these tributaries makes it impossible to state the period of the year through which minimum flows would have to be maintained. Observations have shown that from May through October these streams are dry much of the time in the

upper reaches. In a particularly dry year the period of no flow could be for nearly six months.

The towns of Eupora and Bentonia were constructing waste treatment works during the FWPCA survey. The installation of treatment facilities at Mathiston, Winona, Goodman, Durant and Kearney Park and the replacement of the inadequate treatment plant at Flora would improve the sanitary quality of the main stem.

X. BENEFITS

The foregoing sections of this report show that ground-water supplies are more than ample for present and future needs and are of suitable quality. Projections do not indicate that surface-water supplies will be required for domestic or industrial use through 2015. There would thus be no benefit in developing surface-water sources at present or in the near future for these uses and no such development is recommended. The Corps of Engineers has not proposed any impoundment to date for the Big Black River Basin.

Water quality control benefits are the net contribution to the economy, public health, the enjoyment of water for recreation and the increase in any use of water which is affected by a change in its quality.

If the discharge of wastes prevents the use of a stream for commercial or recreational fishing, there is an economic loss plus an intangible one. Should wastes cause bacterial contamination of a stream, there is a potential public health hazard and an economic loss due to the prohibition put upon the use of its waters for recreation. Such pollution may also make the stream undesirable or unusable as a source for public water supply. Pollution often makes a stream aesthetically undesirable. All of these effects of pollution are important but difficult to evaluate.

As pointed out in the section on Water Quality Control, the assimilative capacity of the Big Black River main stem is sufficient for present and projected waste loads with the exception that would

arise if an existing paper mill is expanded. If this expansion becomes a reality, additional flow would be required below Pickens in periods of low stream flow.

In the absence of means for directly evaluating the benefits that would accrue from water quality control by flow augmentation below Pickens, the cost of the least expensive of several likely alternates for achieving the quality sought can be used as a measure of the benefit. Alternates with estimated costs are as follows:

1. Tertiary treatment of the wastes from a 400 ton per day paper mill would cost an estimated $52,000 per year. This is the annual cost for affecting 98 percent removal of B.O.D. over that for providing 85 percent removal.
2. A system of wells, pumps, piping and aerators to supply up to 119 cfs of water containing 6 mg/l of dissolved oxygen to the river. The estimated cost of this alternate is estimated at $208,000 per year.
3. A waste dispersion pipeline which would release previously treated waste to the river at intervals downstream of Pickens over a 35 mile reach. The arrangement would prevent the occurrence of a D.O. sag to below 4 mg/l. Estimated cost is $239,000 per year.
4. Holding ponds to store the effluent of the secondary treatment at times of low flow. Releases would be made on the basis of river flow. About 6,430 acre-feet would be necessary and the annual cost would be $73,000.

The Corps of Engineers has not proposed any impoundments in the Big Black River Basin. Should an impoundment or impoundments be

considered for the basin above Pickens, the value of storage for low flow augmentation for water quality control would be that of the least costly alternative or $52,000 per year. This amount would be the benefit to accrue from an impoundment or impoundments.

In the case of the tributaries, there is little potential for fish or recreation on them and the benefit which would result from providing the necessary flow is very small.

A lack of knowledge of the duration and magnitude of low flows on the tributaries makes it impossible to estimate the storage requirements for providing the flows necessary for fish habitat or the prevention of nuisance conditions.

The first cost of added treatment required to prevent nuisances, but not necessarily to provide streams with waters suitable at all times for fish, would be as follows:

City	Stream	Added First Cost for Tertiary Treatment
Clinton	Bakers Creek	$ 40,000
Edwards	Bakers Creek	37,800
Raymond	Snake & Bakers Creeks	17,000
Bolton	Bakers Creek	14,800
Canton	Bear Creek	100,700
Winona	Hays Creek	37,800

These costs give a measure of the benefit of storage for water quality control to prevent nuisances in the tributaries if such storage were to be provided.

IX. REFERENCES

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3. Michael Baker, Jr., Inc., Economic Base Study of the Pascagoula, Pearl, and Big Black River Basins Study Area, U. S. Army Corps of Engineers, Mobile District, December 1964.

4. Mississippi Research and Development Center, Mississippi Manufacturers Directory, Jackson, Mississippi, 1964.

5. Bureau of Sports Fisheries and Wildlife, Fish and Wildlife Service, U. S. Department of the Interior, Letter Report on Big Black River Basin to U. S. Army Corps of Engineers, Vicksburg District, April 1, 1966.

6. Mississippi State Oil and Gas Board, Mississippi State Oil and Gas Bulletin, Volume 65, Number 5, Jackson, Mississippi, July 1965.

7. Harvey, E. J. and J. W. Long, Ground-Water Resources of the Jackson Area, Mississippi, Bulletin 58-1, U. S. Geological Survey and Mississippi Board of Water Commissioners, April 1958.

8. Skelton, John, Low-Flow Measurements at Selected Sites on Streams in Mississippi, Bulletin 61-1, U. S. Geological Survey and Mississippi Board of Water Commissioners, March 1961.

Appendix I
DESCRIPTION OF SAMPLING STATIONS 1/
Big Black River Basin

Station 270010 - Big Black River, sec. 42, T. 13 N., R. 3 E., on Warren-Claiborne County line, at bridge on U. S. Highway 61.

Station 270020 - Big Black River, sec. 28, T. 14 N., R. 4 E., on Warren-Claiborne County line, at bridge on county road (Fishers Bridge).

Station 270035 - Big Black River, sec. 32, T. 15 N., R. 5 E., on Warren-Hinds County line, at bridge on Mississippi State Highway 27, southwest of Edwards.

Station 270040 - Fourteenmile Creek, sec. 24, T. 15 N., R. 5 E., in Hinds County, at bridge on county road, southwest of Edwards.

Station 270070 - Big Black River, sec. 22, T. 16 N., R. 5 E., on Warren-Hinds County line, at bridge on Old U. S. Highway 80, east of Bovina.

Station 270080 - Big Black River, sec. 20, T. 6 N., R. 4 W., on Warren-Hinds County line, at bridge on Interstate Highway 20, near Edwards.

Station 270130 - Big Black River, sec. 25, T. 9 N., R. 2 W., on Yazoo-Madison County line, at bridge on U. S. Highway 49, south of Bentonia.

Station 270150 - Bear Creek, sec. 27-28 border line, T. 10 N., R. 2 E., in Madison County, at bridge on county road, northwest of Canton.

Station 270170 - Big Black River, sec. 16, T. 10 N., R. 2 E., on Yazoo-Madison County line, at bridge on Mississippi State Highway 16, northwest of Canton.

Station 270190 - Big Black River, sec. 14, T. 12 N., R. 3 E., on Holmes-Attala County line, at bridge on Old U. S. Highway 51, at Pickens.

Station 270200 - Big Black River, sec. 21, T. 13 N., R., 4 E., on Holmes-Attala County line at bridge on Mississippi State Highway 14, near Goodman.

Station 270210 - Big Black River, sec. 18, T. 14 N., R. 5 E., on Holmes-Attala County line, at bridge on Mississippi State Highway 12, near Durant.

1/ All stations are in the state of Mississippi.

Station 270220 - Big Black River, sec. 3, T. 15 N., R. 5 E., on Holmes-Attala County line, at bridge on Mississippi State Highway 19, at West.

Station 270250 - Hayes Creek, sec. 30, T. 17 N., R. 6 E., in Carroll County, at bridge on Mississippi State Highway 35, southeast of Vaiden.

Station 270260 - Big Black River, sec. 30 T. 17 N., R. 6 E., in Carroll County, at bridge on Mississippi State Highway 35, southeast of Vaiden.

Station 270280 - Big Black River, sec. 36, T. 18 N., R. 6 E., in Montgomery County, at bridge on Mississippi State Highway 407, southwest of Kilmichael.

Station 270300 - Big Black River, sec. 22, T. 18 N., R. 7 E., in Montgomery County, at bridge on Mississippi State Highway 43/413, southeast of Kilmichael.

Station 270310 - Big Bywy Ditch, sec. 14-15 border line, T. 18 N., R. 8 E., in Choctaw County, at bridge on county road, south of Stewart.

Station 270340 - North Diversion Ditch, sec. 15, T. 18 N., R. 7 E., in Montgomery County, at bridge on Mississippi State Highway 43/413, near Kilmichael.

Station 270350 - Big Mulberry Creek, sec. 10, T. 18 N., R. 7 E., in Montgomery County at bridge on U. S. Highway 82, near Kilmichael.

Station 270360 - Big Black River, sec. 10-11 border line, T. 18 N., R. 8 E., on Montgomery-Choctaw County line, at bridge on county road, south of Stewart.

Station 270370 - North Diversion Ditch, sec. 11, T. 18 N., R. 8 E., in Montgomery County, at bridge on county road, near Stewart.

Station 270390 - Big Black River, sec. 16, T. 19 N., R. 10 E., on Webster-Choctaw County line, at bridge on Mississippi State Highway 9, near Eupola.

Station 270400 - Little Black Creek, sec. 5, T. 19 N., R. 10 E., in Webster County, at bridge on U. S. Highway 82, near Eupora.

Appendix II

SURFACE WATER QUALITY DATA

Big Black River Basin

August-October, 1964

STATION 270010 BIG BLACK R. U.S. 61

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	28.88888	1017.900	6.400000	82.10000	1.430000	7.233333	31.00000	35.00000	1408.959	77.33739
NO.	9.000000	10.00000	9.000000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000	9.000000
MIN	27.00000	182.0000	5.700000	73.00000	.7000000	7.000000	5.000000	11.00000	320.0000	20.00000
MAX	30.00000	3250.000	7.400000	91.00000	3.400000	7.500000	73.00000	65.00000	7900.000	330.0000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	60.26666	157.8571	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	52.00000	90.00000	-	-	-	-	-	-	-	-
MAX	72.80000	350.0000	-	-	-	-	-	-	-	-

STATION 270020 BIG BLACK R. FISHERS BRIDGE

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	26.90909	1032.454	6.609090	81.27272	1.610000	7.180000	27.44444	33.66666	6366.193	223.2282
NO.	11.00000	11.00000	11.00000	11.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	17.00000	178.0000	4.700000	59.00000	1.000000	7.000000	3.000000	8.000000	790.0000	18.00000
MAX	31.00000	3550.000	8.200000	94.00000	2.700000	7.500000	46.00000	68.00000	34800.00	1300.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	73.80000	181.4285	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	51.60000	110.0000	-	-	-	-	-	-	-	-
MAX	104.4000	300.0000	-	-	-	-	-	-	-	-

Notes:

1) Results presented herein were compiled by computer facilities; therefore, averages presented may indicate accuracy beyond testing capabilities.

2) Averages shown for bacteriological parameters are geometric means and not arithmetic averages.

Appendix II (Cont.)

STATION 270035 BIG BLACK R. MISS. 27 S.W. EDWARDS

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	27.70000	1076.800	6.570000	82.30000	1.910000	7.220000	30.11111	33.88888	5193.311	384.9308
NO.	10.00000	10.00000	10.00000	10.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	17.00000	167.0000	5.800000	73.00000	1.200000	7.000000	3.000000	10.00000	1100.000	20.00000
MAX	31.00000	3600.000	8.200000	104.0000	2.600000	7.400000	52.00000	71.00000	22000.00	1300.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	58.33333	165.9750	20.00000	198.0000	-	-	.0800000	.2000000	-	-
NO.	3.000000	8.000000	1.000000	1.000000	-	-	1.000000	1.000000	-	-
MIN	54.00000	47.00000	20.00000	198.0000	-	-	.0800000	.2000000	-	-
MAX	66.60000	280.0000	20.00000	198.0000	-	-	.0800000	.2000000	-	-

STATION 270040 FOURTEENMILE CR. CO. RD. S.W. EDWARDS

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	26.92307	31.17692	5.507692	68.30769	2.763636	7.070000	71.30000	49.77777	33489.68	563.9540
NO.	13.00000	13.00000	13.00000	13.00000	11.00000	10.00000	10.00000	9.000000	10.00000	10.00000
MIN	17.00000	.2000000	3.900000	51.00000	1.600000	6.800000	12.00000	19.00000	7800.000	18.00000
MAX	30.00000	145.0000	6.400000	81.00000	4.400000	7.500000	305.0000	95.00000	920000.0	24000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	62.86666	136.5000	40.00000	196.0000	-	-	.1000000	.1000000	-	-
NO.	3.000000	8.000000	1.000000	1.000000	-	-	1.000000	1.000000	-	-
MIN	48.80000	25.00000	40.00000	196.0000	-	-	.1000000	.1000000	-	-
MAX	77.00000	550.0000	40.00000	196.0000	-	-	.1000000	.1000000	-	-

STATION 270070 BIG BLACK R. OLD U.S. 80 E. BOVINA

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	26.76923	993.5454	6.300000	77.30769	1.680000	7.000000	28.22222	26.55555	6547.143	307.3707
NO.	13.00000	11.00000	13.00000	13.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	17.00000	155.0000	5.600000	67.00000	.8000000	6.800000	6.000000	9.000000	790.0000	45.00000
MAX	32.00000	3430.000	8.400000	94.00000	2.600000	7.200000	73.00000	54.00000	160000.0	1720.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	54.00000	210.7142	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	43.20000	85.00000	-	-	-	-	-	-	-	-
MAX	64.00000	450.0000	-	-	-	-	-	-	-	-

Appendix II (Cont.)

STATION 270080 BIG BLACK R. INTERSTATE 20 NEAR EDWARDS

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	27.00000	1291.441	6.453846	80.07692	1.908333	6.966666	26.50000	57.90000	5158.372	242.3289
NO.	13.00000	13.00000	13.00000	13.00000	12.00000	12.00000	12.00000	10.00000	10.00000	10.00000
MIN	17.00000	144.0000	5.000000	56.00000	.8000000	6.700000	6.000000	9.000000	1100.000	20.00000
MAX	31.00000	4140.000	8.300000	105.0000	4.700000	7.300000	71.00000	344.0000	35000.00	2300.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	93.80000	185.5000	30.00000	271.0000	.2475000	.0045000	1.444000	.1680000	3.300000	.1566666
NO.	4.000000	8.000000	1.000000	3.000000	4.000000	4.000000	5.000000	6.000000	2.000000	3.000000
MIN	36.00000	54.00000	30.00000	213.0000	.1000000	.0000000	.0900000	.0000000	3.200000	.0200000
MAX	240.0000	450.0000	30.00000	350.0000	.3200000	.0090000	5.400000	.3500000	3.400000	.2500000

STATION 270130 BIG BLACK R. U.S. 49 S. BENTONIA

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	26.07142	942.0714	6.614285	80.21428	1.516666	6.909090	34.84615	20.66666	6043.938	403.3074
NO.	14.00000	14.00000	14.00000	14.00000	12.00000	11.00000	13.00000	9.000000	11.00000	11.00000
MIN	15.00000	125.0000	5.400000	67.00000	.3000000	6.700000	3.000000	8.000000	460.0000	45.00000
MAX	31.00000	3500.000	8.100000	102.0000	3.000000	7.100000	71.00000	44.00000	54230.00	3300.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	31.66666	187.1428	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	18.80000	75.00000	-	-	-	-	-	-	-	-
MAX	38.60000	300.0000	-	-	-	-	-	-	-	-

STATION 270150 BEAR CR. CO. RD. N.W. CANTON

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	23.83333	23.85454	4.141666	48.25000	4.233333	6.900000	11.18181	24.11111	42393.73	1184.902
NO.	12.00000	11.00000	12.00000	12.00000	12.00000	12.00000	11.00000	9.000000	9.000000	9.000000
MIN	15.00000	.0000000	2.100000	25.00000	2.300000	6.600000	5.000000	7.000000	4900.000	180.0000
MAX	27.00000	125.0000	6.200000	67.00000	7.300000	7.100000	22.00000	42.00000	540000.0	13000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	148.0000	186.4285	-	297.0000	1.040000	.0095000	2.725000	1.348000	3.000000	.2000000
NO.	4.000000	7.000000	-	2.000000	4.000000	4.000000	4.000000	5.000000	2.000000	2.000000
MIN	26.00000	80.00000	-	150.0000	.4000000	.0000000	.1700000	.2000000	3.000000	.2000000
MAX	482.0000	380.0000	-	444.0000	2.600000	.0240000	7.800000	4.200000	3.000000	.2000000

Appendix II (Cont.)

STATION 270170 BIG BLACK R. MISS. 16 N.W. CANTON

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.61538	914.5384	6.784615	79.92307	1.883333	6.811111	27.00000	15.66666	21654.29	654.8187
NO.	13.00000	13.00000	13.00000	13.00000	12.00000	9.000000	11.00000	9.000000	9.000000	9.000000
MIN	15.00000	114.0000	5.200000	62.00000	.6000000	6.500000	1.000000	7.000000	2200.000	18.00000
MAX	29.00000	3750.000	8.400000	100.0000	3.300000	7.000000	97.00000	31.00000	170000.0	7900.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	29.53333	205.0000	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	16.00000	50.00000	-	-	-	-	-	-	-	-
MAX	49.40000	500.0000	-	-	-	-	-	-	-	-

STATION 270190 BIG BLACK R. OLD U.S. 51 PICKENS

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.92307	833.3076	6.315384	74.53846	2.150000	6.700000	5.090909	16.44444	13598.41	1921.014
NO.	13.00000	13.00000	13.00000	13.00000	12.00000	10.00000	11.00000	9.000000	9.000000	9.000000
MIN	14.00000	84.00000	1.600000	20.00000	1.000000	6.400000	2.000000	7.000000	1300.000	200.0000
MAX	29.00000	4650.000	8.500000	92.00000	5.400000	6.900000	10.00000	30.00000	240000.0	24000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	16.80000	189.1666	-	-	-	-	-	-	-	-
NO.	3.000000	6.000000	-	-	-	-	-	-	-	-
MIN	10.80000	75.00000	-	-	-	-	-	-	-	-
MAX	24.00000	320.0000	-	-	-	-	-	-	-	-

STATION 270200 BIG BLACK R. MISS. 14 NEAR GOODMAN

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	26.08333	644.6666	6.933333	84.50000	1.916666	6.920000	6.200000	20.44444	27784.18	10466.67
NO.	12.00000	12.00000	12.00000	12.00000	12.00000	10.00000	10.00000	9.000000	10.00000	10.00000
MIN	17.00000	67.00000	5.400000	64.00000	.9000000	6.400000	2.000000	8.000000	7900.000	3300.000
MAX	30.00000	4600.000	8.700000	110.0000	3.600000	7.200000	11.00000	60.00000	79000.00	49000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	20.53333	143.2500	-	-	-	-	-	-	-	-
NO.	3.000000	8.000000	-	-	-	-	-	-	-	-
MIN	15.20000	100.0000	-	-	-	-	-	-	-	-
MAX	28.40000	250.0000	-	-	-	-	-	-	-	-

Appendix II (Cont.)

STATION 270210 BIG BLACK R. MISS. 12 NEAR DURANT

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	25.83333	535.0833	6.841666	82.83333	1.270000	6.940000	6.000000	19.00000	5423.136	358.2406
NO.	12.00000	12.00000	12.00000	12.00000	10.00000	10.00000	10.00000	9.000000	11.00000	11.00000
MIN	16.00000	50.00000	5.800000	71.00000	.1000000	6.600000	2.000000	9.000000	950.0000	20.00000
MAX	30.00000	3330.000	8.100000	100.0000	2.400000	7.200000	13.00000	52.00000	35000.00	7000.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	21.20000	189.2857	-	-	-	-	-	-	-	-
NO.	2.000000	7.000000	-	-	-	-	-	-	-	-
MIN	16.40000	95.00000	-	-	-	-	-	-	-	-
MAX	26.00000	380.0000	-	-	-	-	-	-	-	-

STATION 270220 BIG BLACK R. MISS. 19 WEST

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.92857	463.7142	6.471428	71.88571	1.891666	6.966666	5.545454	31.72727	14576.05	838.4480
NO.	14.00000	14.00000	14.00000	14.00000	12.00000	12.00000	11.00000	11.00000	11.00000	11.00000
MIN	16.00000	32.00000	3.400000	6.400000	.6000000	6.600000	2.000000	9.000000	4900.000	130.0000
MAX	28.00000	2000.000	8.500000	94.00000	4.300000	7.300000	9.000000	122.0000	79000.00	33000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	19.46666	171.5000	50.00000	160.0000	.4750000	.0337500	.9148000	.2080000	3.400000	-
NO.	3.000000	8.000000	1.000000	3.000000	4.000000	4.000000	5.000000	5.000000	1.000000	-
MIN	15.20000	27.00000	50.00000	100.0000	.1000000	.0000000	.0000000	.0800000	3.400000	-
MAX	27.20000	370.0000	50.00000	278.0000	1.160000	.1200000	4.400000	.4000000	3.400000	-

STATION 270250 HAYES CR. MISS. 35 S.E. VAIDEN

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.42857	4.346153	6.407142	75.92857	3.050000	6.941666	10.27272	42.00000	28582.78	3521.249
NO.	14.00000	13.00000	14.00000	14.00000	12.00000	12.00000	11.00000	11.00000	11.00000	11.00000
MIN	17.00000	.0000000	4.000000	45.00000	.4000000	6.500000	2.000000	14.00000	4900.000	130.0000
MAX	29.00000	15.00000	7.800000	99.00000	6.900000	7.300000	30.00000	134.0000	1600000.	33000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	34.13333	237.8571	-	275.5000	1.505000	.1012500	2.272500	.5940000	3.500000	.2500000
NO.	3.000000	7.000000	-	2.000000	4.000000	4.000000	4.000000	5.000000	2.000000	2.000000
MIN	17.20000	60.00000	-	263.0000	.9800000	.0080000	.1000000	.3000000	3.400000	.2000000
MAX	56.80000	700.0000	-	288.0000	2.400000	.2060000	6.200000	1.040000	3.600000	.3000000

Appendix II (Cont.)

STATION 270260 BIG BLACK R. MISS. 35 S.E. VAIDEN

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	25.91666	381.0000	6.116666	74.09090	1.536363	6.870000	5.333333	17.66666	5427.522	145.6671
NO.	12.00000	11.00000	12.00000	11.00000	11.00000	10.00000	9.000000	9.000000	10.00000	10.00000
MIN	16.00000	27.00000	5.200000	63.00000	.9000000	6.400000	3.000000	10.00000	490.0000	18.00000
MAX	29.00000	1530.000	7.700000	98.00000	2.300000	7.200000	9.000000	40.00000	24000.00	790.0000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	17.80000	127.1428	-	86.00000	-	-	-	-	-	-
NO.	2.000000	7.000000	-	1.000000	-	-	-	-	-	-
MIN	10.80000	75.00000	-	86.00000	-	-	-	-	-	-
MAX	24.80000	240.0000	-	86.00000	-	-	-	-	-	-

STATION 270280 BIG BLACK R. MISS. 407 S.W. KILMICHAEL

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	25.70000	251.6000	7.070000	85.20000	1.460000	6.960000	5.333333	16.66666	8881.879	323.1791
NO.	10.00000	10.00000	10.00000	10.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	15.00000	22.00000	5.600000	67.00000	.8000000	6.500000	2.000000	10.00000	2200.000	18.00000
MAX	30.00000	1440.000	8.900000	93.00000	2.300000	7.200000	8.000000	34.00000	35000.00	2200.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	17.06666	102.1428	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	12.00000	60.00000	-	-	-	-	-	-	-	-
MAX	21.20000	130.0000	-	-	-	-	-	-	-	-

STATION 270300 BIG BLACK R. MISS. 43/413 S.E. KILMICHAEL

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.63636	97.00000	7.445454	90.00000	1.390000	7.060000	4.888888	19.55555	8416.101	500.5227
NO.	11.00000	10.00000	11.00000	10.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	15.00000	10.00000	5.600000	67.00000	.3000000	6.500000	3.000000	10.00000	3300.000	110.0000
MAX	29.00000	620.0000	9.100000	100.0000	2.300000	7.300000	7.000000	38.00000	54000.00	6400.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	16.33333	61.42857	-	-	-	-	-	-	-	-
NO.	3.000000	7.000000	-	-	-	-	-	-	-	-
MIN	14.20000	10.00000	-	-	-	-	-	-	-	-
MAX	18.40000	130.0000	-	-	-	-	-	-	-	-

Appendix II (Cont.)

STATION 270310 BIG BYWY DITCH CO. RD. S. STEWART

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	23.50000	24.04000	8.200000	95.00000	.9666666	6.980000	5.333333	19.22222	8803.220	569.8729
NO.	10.00000	10.00000	10.00000	10.00000	9.000000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	14.00000	7.100000	7.700000	91.00000	.3000000	6.600000	3.000000	9.000000	2300.000	200.0000
MAX	27.00000	89.00000	9.500000	99.00000	1.800000	7.200000	8.000000	46.00000	24000.00	1300.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	14.86666	36.25000	-	-	-	-	-	-	-	-
NO.	3.000000	8.000000	-	-	-	-	-	-	-	-
MIN	12.20000	25.00000	-	-	-	-	-	-	-	-
MAX	19.20000	80.00000	-	-	-	-	-	-	-	-

STA. 270340 N. DIVERSION DITCH MISS. 43/413 NEAR KILMICHAEL

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	25.36363	170.7818	7.445454	87.36363	1.433333	6.910000	7.444444	20.12500	8724.993	529.4136
NO.	11.00000	11.00000	11.00000	11.00000	9.000000	10.00000	9.000000	8.000000	9.000000	9.000000
MIN	15.00000	7.600000	6.000000	67.00000	1.000000	6.500000	3.000000	9.000000	2400.000	110.0000
MAX	30.00000	760.0000	9.600000	98.00000	2.200000	7.100000	20.00000	44.00000	54000.00	7900.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	21.33333	110.8333	-	-	-	-	-	-	-	-
NO.	3.000000	6.000000	-	-	-	-	-	-	-	-
MIN	10.00000	65.00000	-	-	-	-	-	-	-	-
MAX	36.00000	175.0000	-	-	-	-	-	-	-	-

STATION 270350 BIG MULBERRY CR. U.S. 82 NEAR KILMICHAEL

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	23.54545	24.99090	6.490909	75.09090	1.320000	6.863636	4.700000	16.55555	8854.854	290.4543
NO.	11.00000	11.00000	11.00000	11.00000	10.00000	11.00000	10.00000	9.000000	9.000000	9.000000
MIN	14.00000	.8000000	5.100000	58.00000	.4000000	6.500000	2.000000	1.000000	2300.000	20.00000
MAX	27.00000	250.0000	7.600000	90.00000	2.800000	7.100000	9.000000	38.00000	92000.00	790.0000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	15.80000	67.14285	-	-	-	-	-	-	-	-
NO.	2.000000	7.000000	-	-	-	-	-	-	-	-
MIN	11.20000	35.00000	-	-	-	-	-	-	-	-
MAX	20.40000	110.0000	-	-	-	-	-	-	-	-

Appendix II (Cont.)

STATION 270360 BIG BLACK R. CO. RD. S. STEWART

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	25.55555	-	2.666666	32.11111	3.637500	6.577777	2.142857	16.85714	4225.490	126.4332
NO.	9.000000	-	9.000000	9.000000	8.000000	9.000000	7.000000	7.000000	8.000000	8.000000
MIN	21.00000	-	1.300000	16.00000	1.200000	6.400000	2.000000	9.000000	460.0000	20.00000
MAX	28.00000	-	6.200000	76.00000	7.200000	6.700000	3.000000	21.00000	92000.00	1100.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	17.00000	51.85714	-	-	-	-	-	-	-	-
NO.	2.000000	7.000000	-	-	-	-	-	-	-	-
MIN	15.20000	20.00000	-	-	-	-	-	-	-	-
MAX	18.80000	120.0000	-	-	-	-	-	-	-	-

STATION 270370 NORTH DIVERSION DITCH CO. RD. NEAR STEWART

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.63636	184.7111	6.927272	82.00000	1.787500	6.809090	5.625000	15.87500	17670.18	1306.751
NO.	11.00000	9.000000	11.00000	9.000000	8.000000	11.00000	8.000000	8.000000	8.000000	8.000000
MIN	15.00000	5.400000	6.000000	71.00000	.8000000	6.400000	2.000000	9.000000	2300.000	180.0000
MAX	28.00000	1300.000	9.500000	93.00000	2.500000	7.200000	12.00000	38.00000	160000.0	35000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	16.40000	145.7142	-	-	-	-	-	-	-	-
NO.	2.000000	7.000000	-	-	-	-	-	-	-	-
MIN	15.60000	25.00000	-	-	-	-	-	-	-	-
MAX	17.20000	400.0000	-	-	-	-	-	-	-	-

STATION 270390 BIG BLACK R. MISS. 9 NEAR EUPORA

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.40000	82.52000	6.220000	73.10000	2.280000	6.790000	6.333333	24.22222	57886.06	12397.54
NO.	10.00000	10.00000	10.00000	10.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	15.00000	1.300000	3.400000	40.00000	.1000000	6.400000	2.000000	10.00000	13000.00	1300.000
MAX	28.00000	660.0000	8.300000	87.00000	4.600000	7.000000	17.00000	91.00000	330000.0	79000.00

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	20.13333	110.8750	-	-	-	-	-	-	-	-
NO.	3.000000	8.000000	-	-	-	-	-	-	-	-
MIN	14.40000	42.00000	-	-	-	-	-	-	-	-
MAX	26.00000	240.0000	-	-	-	-	-	-	-	-

Appendix II (Cont.)

STATION 270400 LITTLE BLACK CR. U.S. 82 NEAR EUPORA

	WATER TEMP CENT	STREAM FLOW CUFT/SEC	DO MG/L	DO SATUR PERCENT	BOD 5 DAY MG/L	PH S U	CHLORIDE CL MG/L	T ALK CACO3 MG/L	COLIFORM MPN CONF /100ML	FEC COLI EC 44.5 T./100ML
AVE	24.10000	3.030000	5.410000	62.60000	1.950000	6.710000	4.666666	20.66666	23716.09	1835.447
NO.	10.00000	10.00000	10.00000	10.00000	10.00000	10.00000	9.000000	9.000000	9.000000	9.000000
MIN	15.00000	.6000000	1.100000	14.00000	1.100000	6.400000	2.000000	14.00000	7900.000	610.0000
MAX	27.00000	9.700000	8.500000	84.00000	3.100000	7.200000	7.000000	52.00000	140000.0	7000.000

	TOT HARD CACO3 MG/L	TURB JKSN JU	COLOR PT-CO UNITS	RESIDUE TOTAL MG/L	AMMONIA NH3-N MG/L	NITRITE NO2-N MG/L	NITRATE NO3-N MG/L	T PO4 PO4 MG/L	IRON TOTAL UG/L	MANGNESE TOTAL UG/L
AVE	20.13333	145.5000	-	-	-	-	-	-	-	-
NO.	3.000000	8.000000	-	-	-	-	-	-	-	-
MIN	18.00000	34.00000	-	-	-	-	-	-	-	-
MAX	22.40000	300.0000	-	-	-	-	-	-	-	-

Notes:

1) Results presented herein were compiled by computer facilities; therefore, averages presented may indicate accuracy beyond testing capabilities.

2) Averages shown for bacteriological parameters are geometric means and not arithmetic averages.

APPENDIX III

EXHIBITS

Exhibit 1

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW 1/

BIG BLACK RIVER

Period (Consecutive days)	Annual low flow, in cubic feet per second, for indicated recurrence interval in years.						
	1.03	1.2	2	5	10	20	30
			Pickens, Mississippi				
7	158	100	61	44	38	34	29
15	190	113	67	47	41	36	30
30	257	142	76	50	44	39	32
60	440	210	98	58	50	43	35
120	1,140	500	208	110	80	61	45
183	2,240	900	355	180	130	98	70
			Bovina, Mississippi				
7	330	198	122	85	74	66	62
15	410	230	135	92	80	71	66
30	560	286	150	99	86	76	70
60	1,020	445	195	114	96	83	76
120	2,160	910	368	188	140	108	94
183	4,000	1,740	680	318	225	172	150

1/ Final regionalized data for Base Period 1929-57 prepared by U.S.G.S.

Exhibit 2
FLOW DURATION
BIG BLACK RIVER

Percent of time*	Discharge (cfs)	
	Pickens Gauge	Bovina Gauge
99.5	37	70
99	42	78
98	48	90
95	62	116
90	85	157
80	136	250
70	208	388
60	326	610
50	540	1,030
40	910	1,790
30	1,600	3,050
20	2,800	5,300
10	5,000	9,600
5	7,600	14,400
2	11,700	20,600
1	15,200	25,500
0.5	19,200	30,800

* Percent of time daily discharge equals or exceeds that shown.

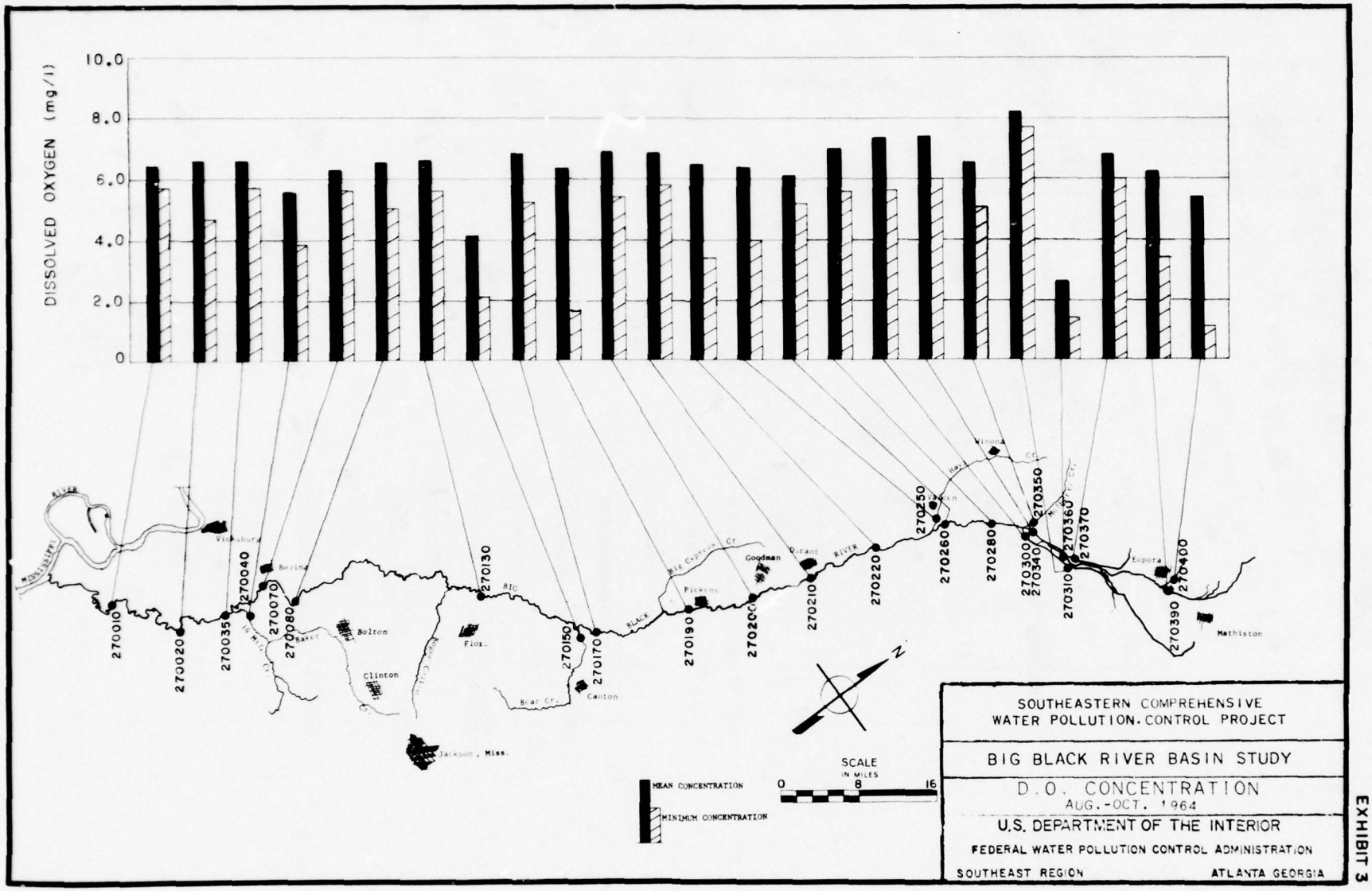
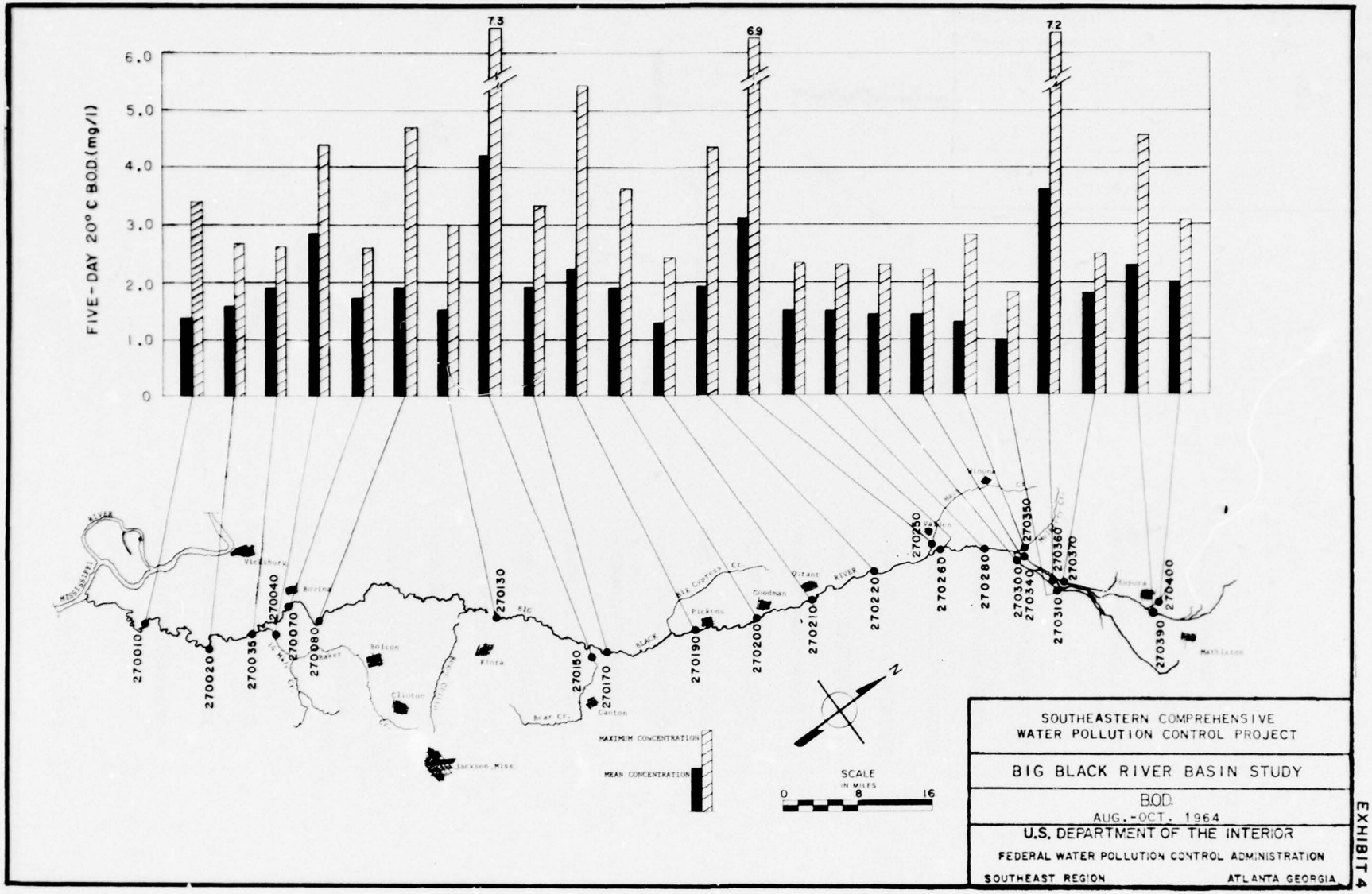

DISSOLVED OXYGEN (mg/l)
10.0
8.0
6.0
4.0
2.0
0
270010
270020
270035
270040
270070
270080
270130
270150
270170
270190
270200
270210
270220
270250
270260
270280
270300
270340
270350
270360
270370
270310
270390
270400
Vicksburg
Bolton
Clinton
Flora
Bear Cr.
Canton
Pickens
Goodman
Durant
Kilmichael Cr.
Eupora
Mathiston
Jackson, Miss.
MEAN CONCENTRATION
MINIMUM CONCENTRATION
SCALE IN MILES
0
8
16
N
SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN STUDY
D.O. CONCENTRATION
AUG.-OCT. 1964
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA GEORGIA

EXHIBIT 3



SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT

BIG BLACK RIVER BASIN STUDY

B.O.D.

AUG.-OCT. 1964

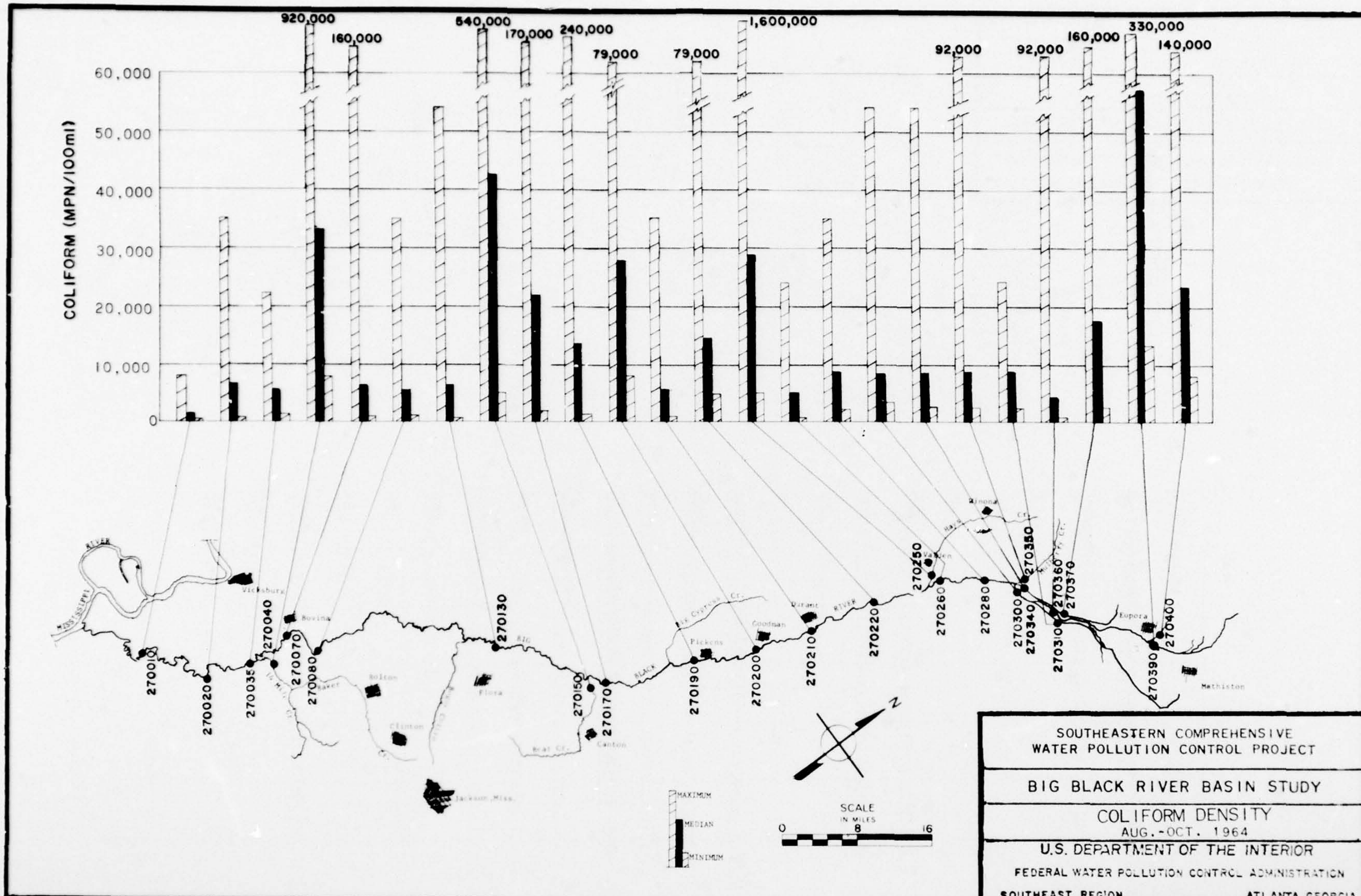
U.S. DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

SOUTHEAST REGION ATLANTA GEORGIA

EXHIBIT 4

EXHIBIT 5



SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT

BIG BLACK RIVER BASIN STUDY

COLIFORM DENSITY
AUG.-OCT. 1964

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION ATLANTA GEORGIA

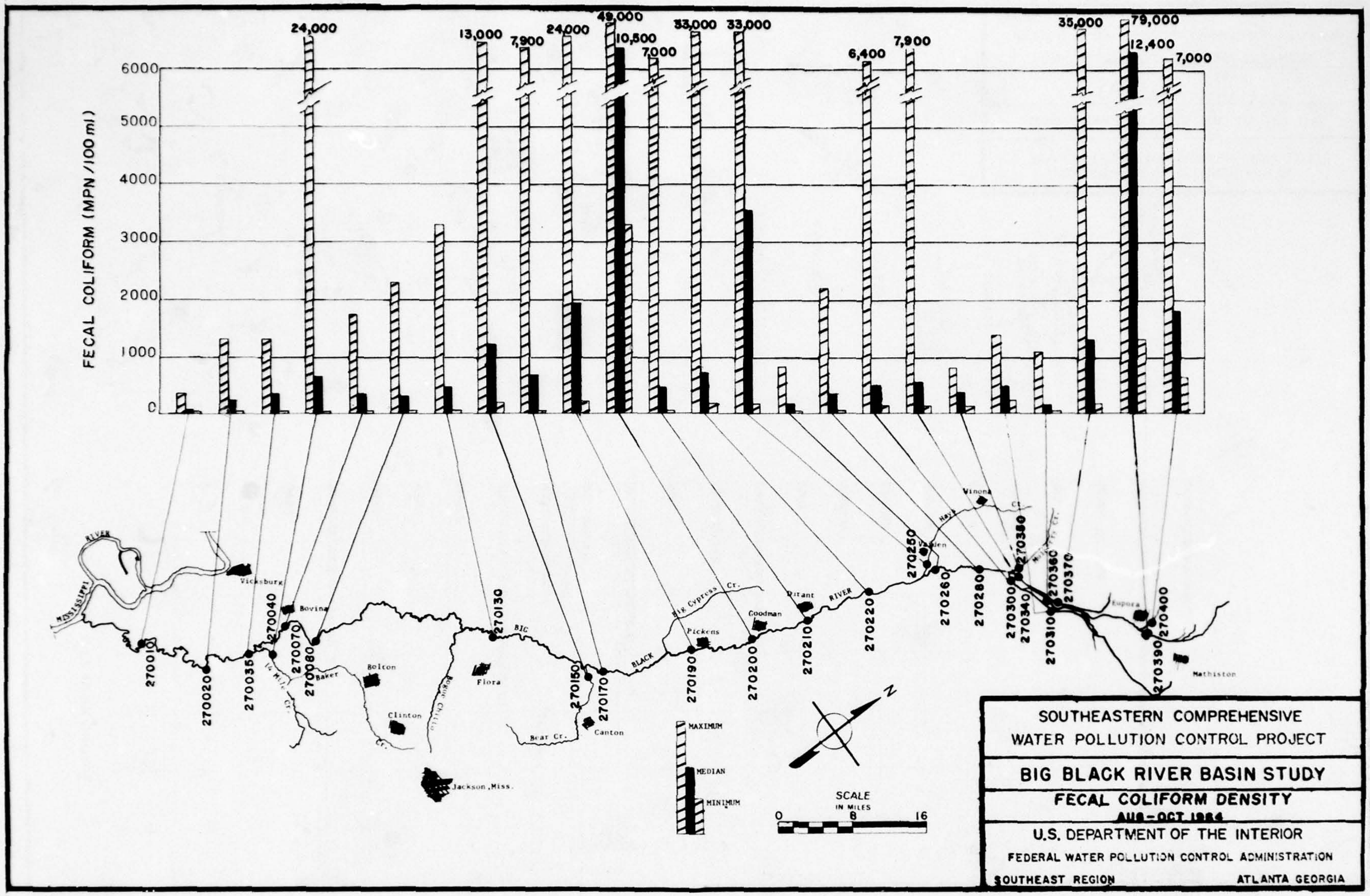

FECAL COLIFORM (MPN /100 ml)
6000
5000
4000
3000
2000
1000
0
24,000
13,000
7,900
24000
49,000
10,500
7,000
33,000
33,000
6,400
7,900
35,000
79,000
12,400
7,000
270010
270020
270035
270040
270070
270080
270130
270150
270170
270190
270200
270210
270220
270250
270260
270280
270300
270340
270380
270310
270360
270370
270390
270400
MISSISSIPPI
RIVER
Vicksburg
Bovina
Baker
Bolton
Clinton
Flora
Jackson, Miss.
Bear Cr.
Canton
BIG
BLACK
RIVER
Big Cypress Cr.
Pickens
Goodman
Durant
Vaiden
Winona
Eupora
Mathiston
MAXIMUM
MEDIAN
MINIMUM
N
SCALE
IN MILES
0
8
16
SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN STUDY
FECAL COLIFORM DENSITY
AUG-OCT 1964
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA GEORGIA

EXHIBIT 6

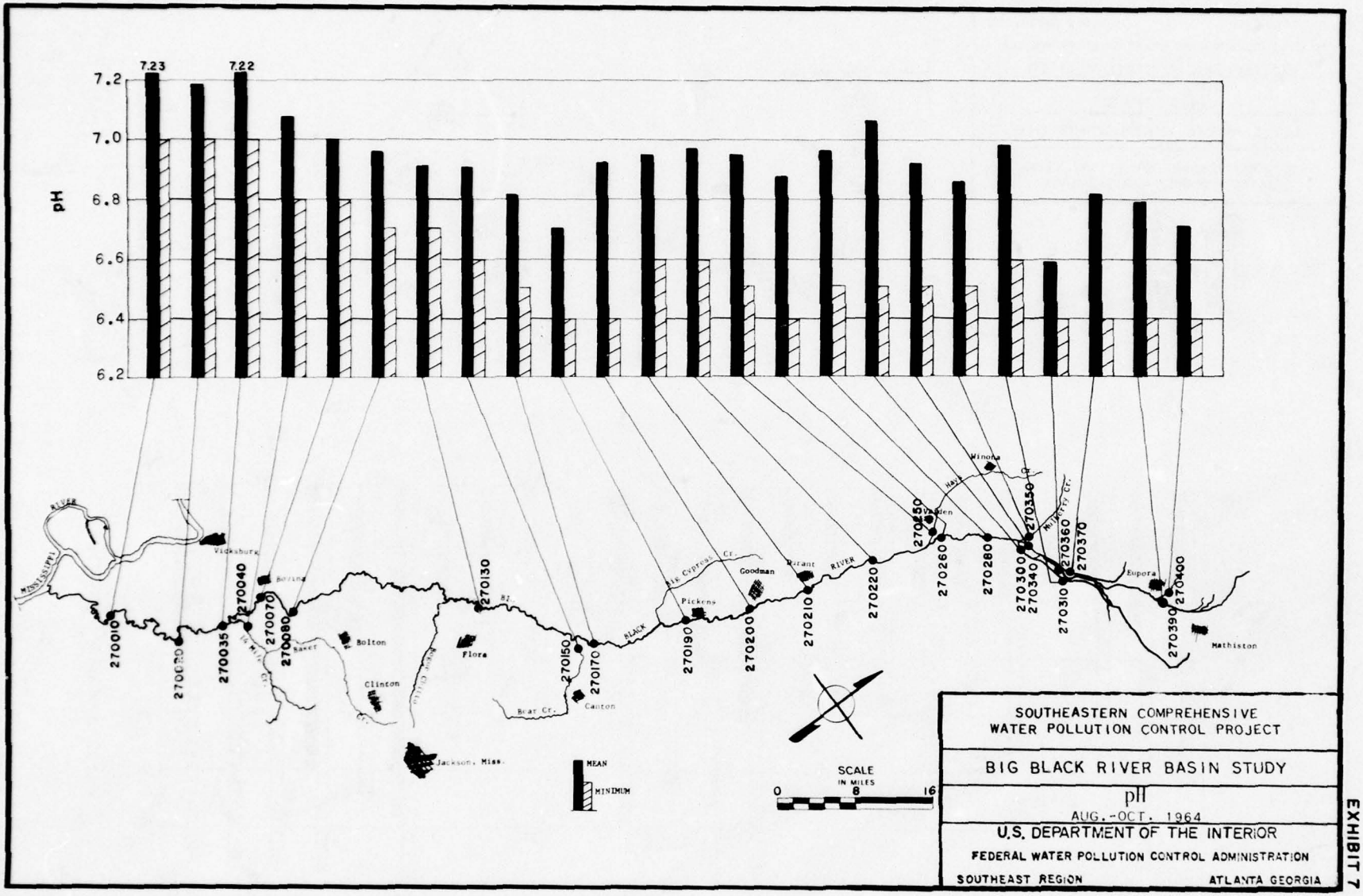
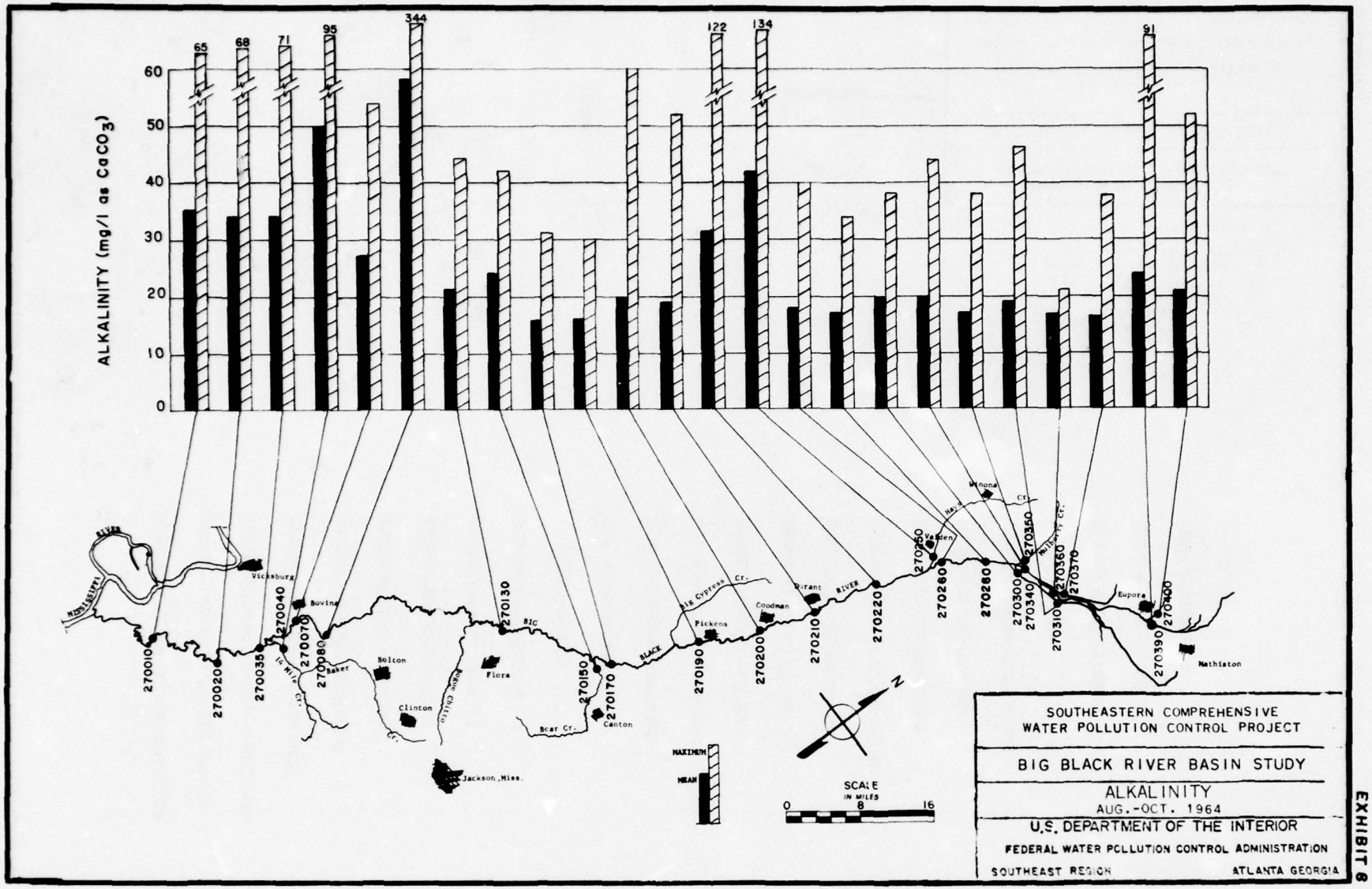

pH
7.2
7.0
6.8
6.6
6.4
6.2
7.23
7.22
MISSISSIPPI RIVER
Vicksburg
Bovina
Bolton
Baker
Clinton
Flora
Bear Cr.
Canton
Big Cypress Cr.
Pickens
Goodman
Durant
RIVER
Winona
Hays Cr.
Kilgore Cr.
Eupora
Mathiston
Jackson, Miss.
270010
270030
270035
270040
270070
270080
270130
270150
270170
270190
270200
270210
270220
270260
270280
270300
270310
270340
270350
270360
270370
270390
270400
MEAN
MINIMUM
SCALE
IN MILES
0
8
16
SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN STUDY
pH
AUG.-OCT. 1964
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA GEORGIA

EXHIBIT 7



SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT

BIG BLACK RIVER BASIN STUDY

ALKALINITY

AUG.-OCT. 1964

U.S. DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

SOUTHEAST REGION ATLANTA GEORGIA

EXHIBIT 8

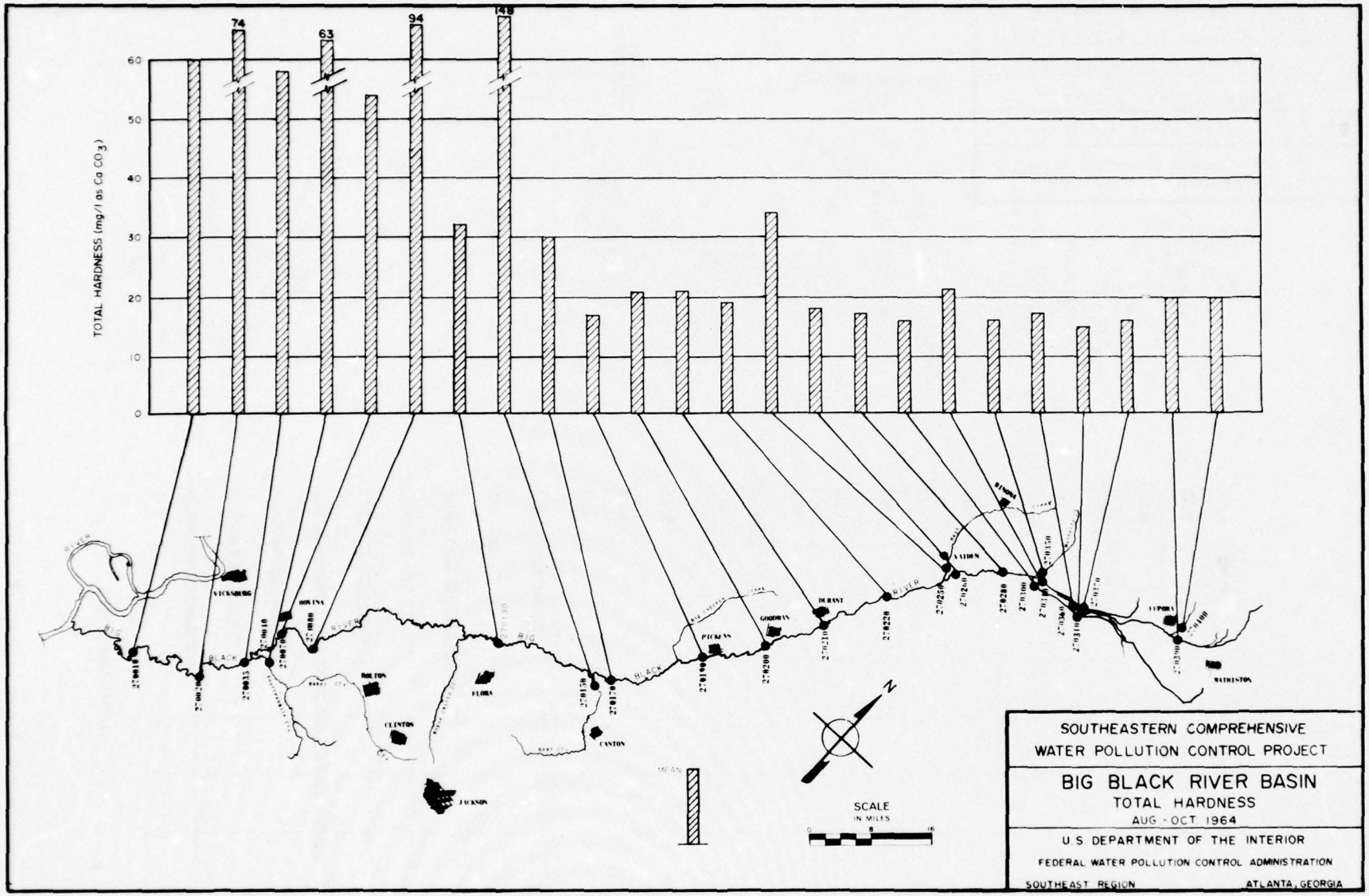

TOTAL HARDNESS (mg/l as Ca CO3)
74
63
94
148
60
50
40
30
20
10
0
VICKSBURG
BOVINA
BOLTON
CLINTON
FLORA
RAYMOND
VAIDEN
DURANT
GOODRUM
PICKENS
CANTON
UTICA
WATHISTON
JACKSON
SCALE
IN MILES
SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN
TOTAL HARDNESS
AUG - OCT 1964
U.S DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA, GEORGIA

EXHIBIT 9

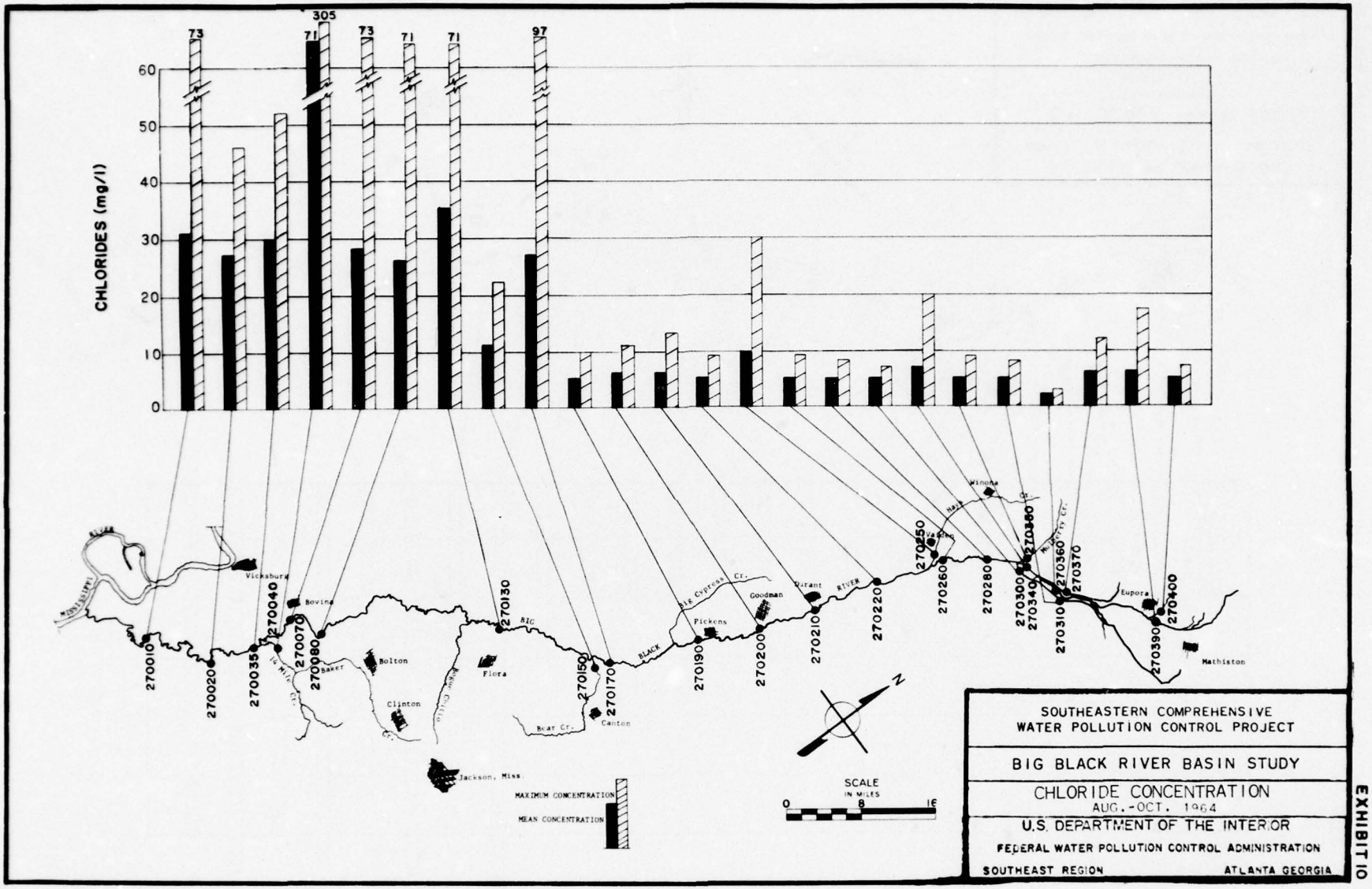
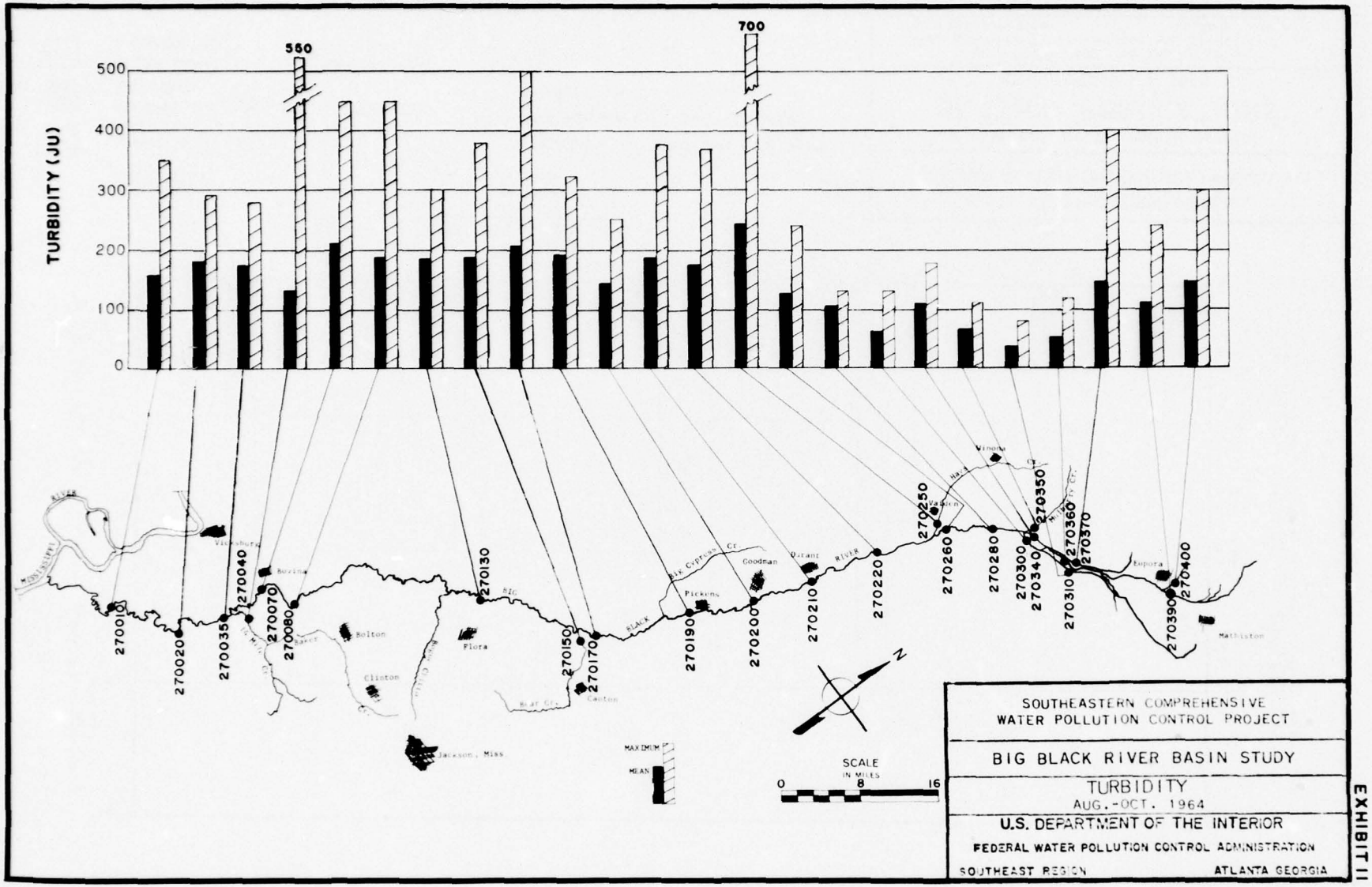

CHLORIDES (mg/l)
0
10
20
30
40
50
60
73
71
305
73
71
71
97
270010
270020
270035
270040
270070
270080
270130
270150
270170
270190
270200
270210
270220
270250
270260
270280
270300
270340
270310
270360
270370
270390
270400
Vicksburg
Bovina
Bolton
Baker
Clinton
Flora
Canton
Pickens
Goodman
Durant
Winona
Eupora
Mathiston
Jackson, Miss.
Big Cypress Cr.
Bear Cr.
MAXIMUM CONCENTRATION
MEAN CONCENTRATION
SCALE
IN MILES
0
8
16
N
SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN STUDY
CHLORIDE CONCENTRATION
AUG.-OCT. 1964
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION
ATLANTA GEORGIA

EXHIBIT 10



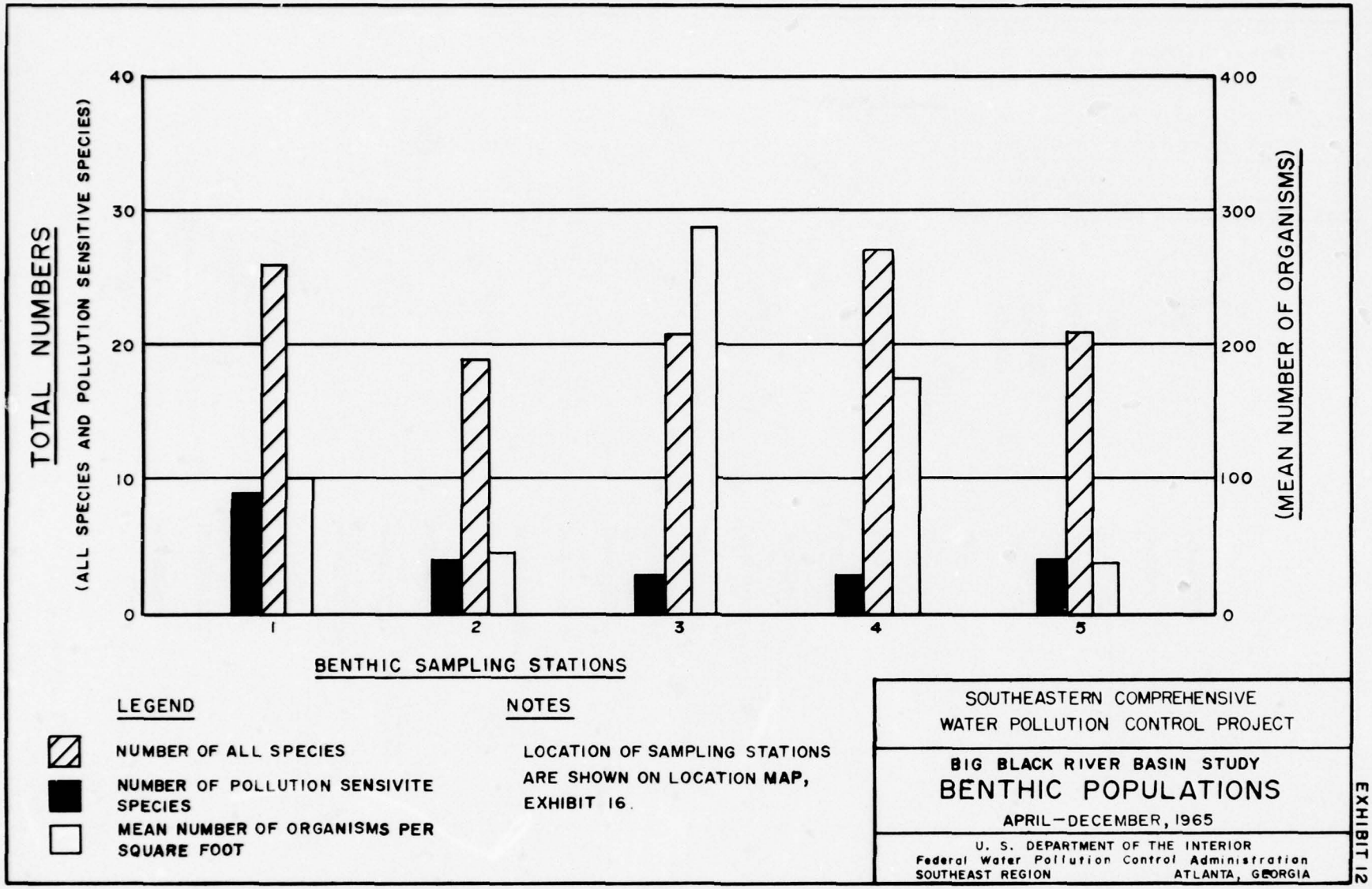
SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT

BIG BLACK RIVER BASIN STUDY

TURBIDITY
AUG.-OCT. 1964

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION ATLANTA GEORGIA

EXHIBIT II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(ALL SPECIES AND POLLUTION SENSITIVE SPECIES)
40
30
20
10
0
400
300
200
100
0
(MEAN NUMBER OF ORGANISMS)
1
2
3
4
5
BENTHIC SAMPLING STATIONS
LEGEND
NUMBER OF ALL SPECIES
NUMBER OF POLLUTION SENSIVITE SPECIES
MEAN NUMBER OF ORGANISMS PER SQUARE FOOT
NOTES
LOCATION OF SAMPLING STATIONS ARE SHOWN ON LOCATION MAP, EXHIBIT 16.
SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT
BIG BLACK RIVER BASIN STUDY
BENTHIC POPULATIONS
APRIL—DECEMBER, 1965
U. S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTHEAST REGION ATLANTA, GEORGIA
EXHIBIT 12

Exhibit 13
MUNICIPAL WATER SUPPLY SYSTEMS
Big Black River Basin
1965

Municipality 1/	Population 1960	Estimated population served	Source of supply	Treatment 2/	Current capacity (mgd)	Estimated average demand (mgd)
Benton	150	100	3 Deep Wells	None	.100	.007
Bentonia	511	500	2 Deep Wells	DC	.230	.035
Bolton	797	795	2 Deep Wells	DC	.730	.08
Canton	9,707	9,850	4 Deep Wells	DC	4.500	1.20
Clinton	3,438	3,440	4 Deep Wells	DC KP	2.500	.30
Durant	2,617	2,615	2 Deep Wells	DC VA	1.430	.19
Edwards	1,206	1,205	2 Deep Wells	None	1.000	.08
Eupora	1,468	1,465	4 Deep Wells	I-AC CL MTPS SV FA DC	1.700	.15
Flora	743	655	2 Deep Wells	VT DH	.400	.06
Goodman	932	640	2 Deep Wells	None	.600	.05
Kearney Industrial Park (Flora) 3/	---	250	2 Deep Wells	None	1.600	0.05
Kilmichael	532	530	2 Deep Wells	I-AO CL DH SC FPS	.180	.037

Exhibit 13 (cont'd)

Municipality 1/	Population 1960	Estimated population served	Source of supply	Treatment 2/	Current capacity (mgd)	Estimated average demand (mgd)
Maben	696	695	2 Deep Wells	None	4/	.05
Mathiston	597	595	2 Shallow Wells	P-AM CS MB SC FRS DH	.100	.05
Montgomery County High School (Kilmichael)	---	1,120	1 Deep Well	None	.165	.023
Oakley Training School	---	350	2 Deep Wells	None	.072	.035
Pickens	727	1,000	2 Deep Wells	None	1.800	.28
Raymond	1,381	1,400	3 Deep Wells	None	1.700	.12
Utica	764	765	2 Deep Wells	KP DC	0.36	.08
Vaiden	475	475	2 Deep Wells	HI-AC SBO FPZ DC	4/	.035
Waterways Experiment Sta., Clinton (U.S.C. of E.)	150	150	2 Deep Wells	DC	0.49	4/
Walthall Water Assoc. (Webster County)	153	350	1 Deep Well	None	0.26	.025
West	282	280	2 Deep Wells	None	0.20	.021

Exhibit 13 (Cont'd)

Municipality 1/	Population 1960	Estimated population served	Source of supply	Treatments 2/	Current capacity (mgd)	Estimated average demand (mgd)
Winona	4,282	4,400	2 Deep Wells	I-AT SC FPS DC	2.70	.05

1/ The term municipality here includes systems owned and operated by governmental entities, private utility bodies serving the public, and other suppliers of water for domestic use.

2/ Explanation of symbols indicating treatment:

P - purification
I - iron or manganese removal
AC - aeration by contact beds or trays
AM - patented aerator
AT - aeration by overflow trays, cascading, etc.
AO - aeration by other devices
CL - chemical dosage with lime
CS - chemical dosage with soda ash
DC - disinfection with chlorine gas
DH - disinfection with hypochlorites
FA - anthrafilt filter
FPS - pressure filter using sand
FPZ - pressure filter with zeolite
FRS - rapid sand filter, gravity type
KP - alkali feed for pH adjustment
MB - mixing with baffled tank
MTPS SV - "accelerator" or similar device
SBO - open, baffled sedimentation basin
SC - settling in covered basins
VA - fluoridation with hydrofluosilicic acid
VT - fluoridation with sodium fluoride

3/ This supply provides water for both industrial and domestic use.

4/ Information not available.

Exhibit 14
MUNICIPAL WASTE DISCHARGES
Big Black River Basin
1965

Municipality 1/	Population 1960 census	Estimated population served	Estimated average flow (mgd)	Type treatment	Design capacity P.E. 2/	Design capacity (mgd)	Estimated P.E. 2/ Untreated waste	Estimated P.E. 2/ Discharged waste	Receiving Stream
Bentonia	511	500	.050	Lagoon 3/	780 3/	0.078 3/	--	--	Creek
Big Black High School (Kilmichael)	--	560 4/	.011	Septic tank and sand filter	Unknown	Unknown	112	12	Creek
Bolton	797	500	.050	Septic tank	300	0.030	500	400	Bakers Creek
Bovina Elementary School	--	175 4/	.003	Septic tank and sand filter	Unknown	Unknown	35	5	Branch to Muddy Creek
Canton	9,707								
No. 1	--	243	.024	Lagoon	1,500	0.150	243	25	Town Creek to Bear Creek
No. 2	--	600	.060	Lagoon	1,500	0.150	600	60	Town Creek to Bear Creek
No. 3	--	2,595	.300	Lagoon	6,000	0.600	2,595	260	Bear Creek
No. 4	--	6,572	.740	Lagoon	13,800	1.380	8,772	880	Walnut Creek to Bear Creek
Carver Elementary Jr. High (Raymond)	--	630 4/	.013	Septic tank and sand filter	Unknown	Unknown	126	13	Creek

Exhibit 14 (Cont'd)

Municipality 1/	Population 1960 census	Estimated population served	Estimated average flow (mgd)	Type treatment	Design capacity P.E. 2/	Design capacity (mgd)	Estimated P.E. 2/ Untreated waste	Estimated P.E. 2/ Discharged waste	Receiving Stream
Clinton	3,438								
No. 1	--	3,000	.360	Lagoon	5,190	0.519	3,000	300	Lindsey Creek to Bakers Creek
No. 2	--	2,000	.240	Lagoon	3,000	0.300	2,000	200	Bakers Creek
Durant	2,617	2,240	.220	None	--	--	2,240	2,240	Big Black River
Edwards	1,206	800	.080	Septic tank	600	0.060	800	720	Bakers Creek
Eupora	1,468	1,572	.187	Lagoon 5/	1,500 5/	0.150 5/	1,572	1,572 5/	Little Black Cr.
Flora	743	800	.080	Septic tank	500	0.050	800	720	Creek
French Camp Academy	---	140	.014	Lagoon	150	0.014	140	15	Dancing Rapid Creek to Poplar Creek
Gibbs Elementary School (near Bentonia)	--	840 4/	.025	Lagoon	300	0.030	168	20	Creek
Goodman	932	1,000	.100	None	--	--	1,000	1,000	Big Black Creek
Kearney Industrial Park (Flora)	--	400	.040	None	--	--	400	400	Big Black Creek
Long Creek School (Attala County near Sallis)	--	1,015 4/	.020	Septic tank and sand filter	Unknown	Unknown	200	20	Bogue Falaya

Exhibit 14 (Cont'd)

Municipality 1/	Population 1960 census	Estimated population served	Estimated average flow (mgd)	Type treatment	Design capacity P.E. 2/	Design capacity (mgd)	Estimated P.E. 2/ Untreated waste	Estimated P.E. 2/ Discharged waste	Receiving Stream
Madison	703	750	.064	Lagoon	1,800	0.180	750	75	Bear Creek
Mathiston	579	150	.012	None	--	--	579	150	Pigeon Roast Cr.
Montgomery Co. High School (Kilmichael)	--	1,120 4/	.020	Lagoon	450	0.045	220	25	Mulberry Creek
Oakley Training School	--	350	.035	Lagoon	600	0.060	350	35	Ditch to Fourteenmile Cr.
Pickens	727	750	.108	Lagoon 5/	1,680 5/	0.168 5/	750	750 5/	Big Black River
Raymond	1,381								
No. 1	--	1,000	.100	Lagoon	6,000	0.600	1,000	100	Snake Creek to Bakers Creek
No. 2	--	200	.020	Lagoon	300	0.030	200	20	Fourteenmile Cr.
Reubin Elementary Jr. High (Bolton)	--	735 4/	.015	Septic tank and sand filter	Unknown	Unknown	147	15	Creek
Sumner Hill Elementary School (Clinton)	--	900 4/	.014	Lagoon	900 3/	0.090	180	20	Fence Creek to Bogue Chitto Cr.
Sumner Hill School (Clinton)	--	245 4/	.005	Septic tank and sand filter	Unknown	Unknown	50	5	Creek
Utica	764	570	.060	Lagoon	1,800	0.180	570	60	Fivemile Creek

Exhibit 14 (Cont'd)

Municipality 1/	Population 1960 census	Estimated population served	Estimated average flow (mgd)	Type treatment	Design capacity P.E. 2/	Design capacity (mgd)	Estimated P.E. 2/ Untreated waste	Estimated P.E. 2/ Discharged waste	Receiving Stream
Velma Jackson School (Camden)	--	524 4/	.008	Septic tank and sand filter	Unknown	Unknown	105	10	Hobuck Creek
Waterways Experiment Sta., Clinton (U.S.C. of E.)	150	130	.020	Lagoon	200	0.02	26	5	Bakers Creek
Winona	4,282	3,500	.350	None	--	--	3,500	3,500	Hays Creek

1/ The term municipality includes systems owned and operated by governmental entities, public and private institutions, etc., discharges either domestic wastes or a combination of domestic and industrial wastes.

2/ Population equivalents.

3/ Lagoon had been constructed but sewerage was not complete at time of survey. No wastes were being discharged to river. Present discharge is estimated at 50 P.E.

4/ Day students only. The waste of each such student is estimated at 0.2 of a P.E.

5/ Under construction at time of survey. P.E. discharged will be 90% of figure shown in table.

Exhibit 15

INDUSTRIAL WASTE DISCHARGES

Big Black River Basin

1965

Location	Type of Industry	Type of waste	Estimated Average Flow (mgd)	Type of Treatment	Estimated P.E. 1/ Untreated Waste	Estimated P.E. 1/ Discharged Waste	Receiving Stream
Canton	Wood preserving	Creosoting	2/	Holding Pond	2/	2/	Overflow to Town Creek
	Poultry processing	Wash water	0.08	3/	2,200	--	--
	Dairy	Wash water	0.04	Lagoon	964	480	Bear Creek
Kearney Ind. Park (Flora)	Metal products	Acid wastes	0.02	Clarifier	--	--	Big Black River
Learned	Wood preserving	Creosoting	0.025	Holding pond	2/	2/	Overflow to Ferrel Creek
Pickens	Paper mill 4/	Paper mill wastes	0.21	None	1,000	1,000	Big Black River
Stewart	Wood preserving	Creosoting	2/	2/	2/	2/	Overflow to branch thence to Big Black River

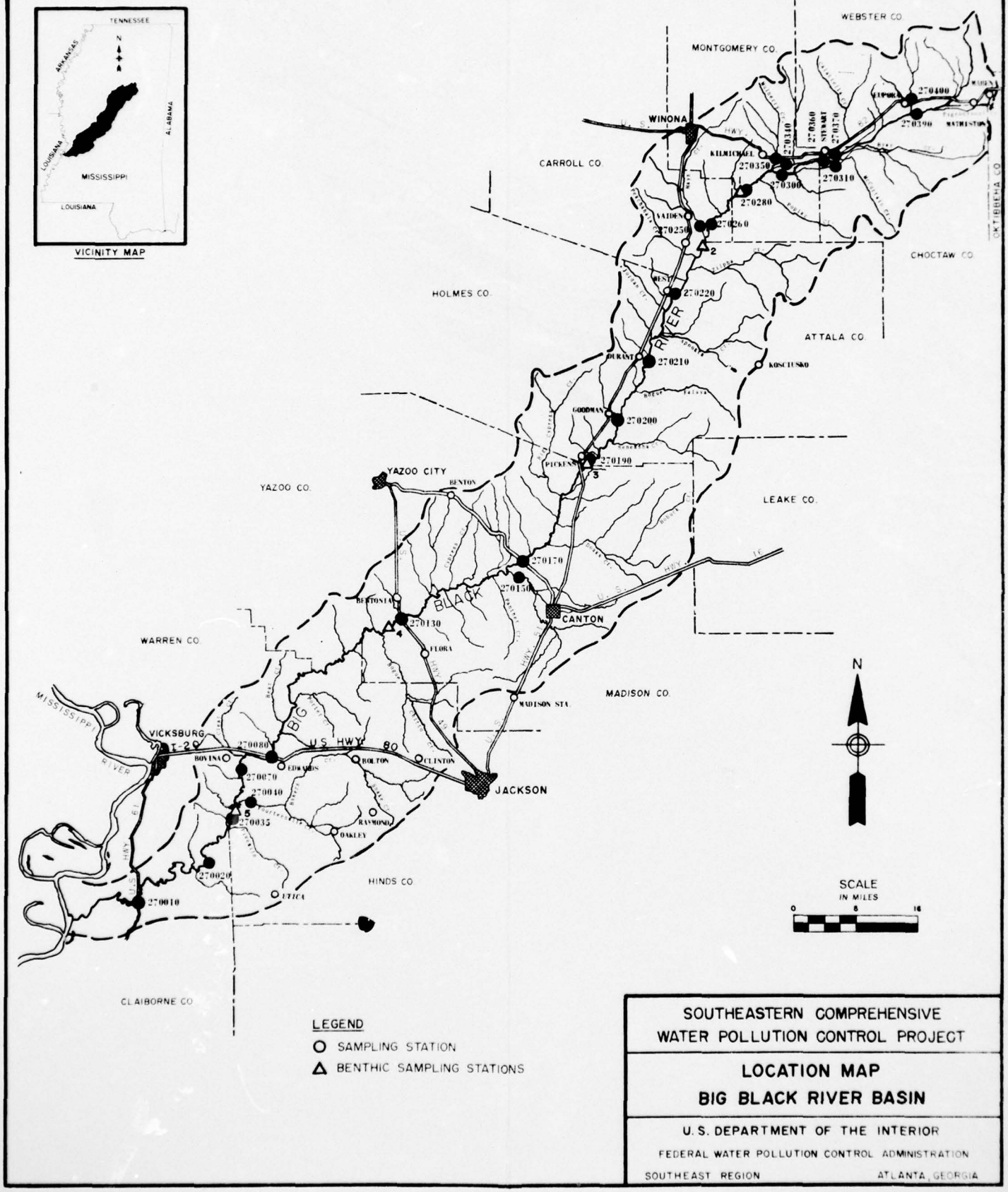
1/ Population Equivalent.

2/ Data not available.

3/ Receives treatment in city treatment plant.

4/ This mill, which manufactured paper from pulp brought in from elsewhere, has ceased operations since the survey. The plant is for sale and may be operated in the future.

EXHIBIT 16



SOUTHEASTERN COMPREHENSIVE
WATER POLLUTION CONTROL PROJECT

LOCATION MAP
BIG BLACK RIVER BASIN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHEAST REGION ATLANTA, GEORGIA

BIG BLACK RIVER, MISSISSIPPI
COMPREHENSIVE BASIN STUDY

Annex F
Geology and Water Resources of the
Big Black River Basin, Mississippi
by
B. E. Wasson

Prepared by
U. S. Geological Survey
Water Resources Division
April 1968

CONTENTS

ILLUSTRATIONS

TABLES

GEOLOGY AND WATER RESOURCES OF THE BIG BLACK RIVER BASIN, MISSISSIPPI

by

B. E. Wasson

ABSTRACT

Abundant supplies of water of good quality are available in the Big Black River basin from either ground-water or surface-water sources. For 90 percent of the time flow in the lower part of the Big Black River below Pickens is not less than 85 cfs (cubic feet per second), and low flows of more than 5 cfs are available in five of the eastern tributary streams in the upper half of the basin. Chemical quality of water in the streams is excellent, except for impairment caused by pollution at several places.

The Big Black River basin is underlain by several thousand feet of clay, silt, sand, gravel, and limestone. This sedimentary material is mostly loose to semiconsolidated and is stratified. The beds dip to the southwest at the rate of 20 to 50 feet per mile. The Big Black River flows southwestward but at a lower gradient; therefore, any specific formation is at a greater depth below the river the farther one goes down stream. The formations crop out in northwest-southeast trending belts.

Most of the available ground water is contained in six geologic units; thickness of these individual units ranges from 100 to 1,000 feet. The aquifers overlap to the extent that a well drilled to the base of fresh water will in most places penetrate two or more aquifers. Well depths range from less than 10 to 2,400 feet.

Water suitable for most needs can be obtained from the aquifers available at most localities. Dissolved-solids content of water within an aquifer increases down the dip. Also, generally the deeper a well is the higher will be the dissolved-solids content of the water. Shallow ground water (less than 200 feet deep) in the basin usually contains about 100 ppm (parts per million) of dissolved solids. Most water in the basin from more than 2,500 feet below land surface contains more than 1,000 ppm of dissolved solids. In several areas fresh water is deeper than 2,500 feet, but near the mouth of the Big Black River brackish water is only about 300 feet below land surface.

Practically all water pumped for man's use in the basin is from the ground (about 11 mgd); however, a small amount of surface water is used for supplemental irrigation of row crops. Wells producing 500 to 1,000 gpm (gallons per minute) are not unusual in the basin. Most of the area is underlain by one or more aquifers from which a properly constructed well could produce as much as 2,000 gpm. All the towns in the area have sufficient ground water available to at least double or triple their ground-water pumpage.

SCOPE AND PURPOSE OF REPORT

This report is a summary description of the geohydrology and water resources of the Big Black River basin and of ground water-surface water relationships; it is based principally on data in the files of the U.S. Geological Survey and on published reports covering parts of the basin and adjacent areas.

The study was made by the Water Resources Division of the U.S. Geological Survey as a part of the interagency comprehensive study of the Big Black River basin. The purpose of the studies is to present facts that will lead to optimum development of the natural and cultural resources of the basin.

DESCRIPTION OF AREA

The long and narrow (160 miles long and 20 to 25 miles wide) Big Black River basin is in west-central Mississippi (fig. 1). Land-surface altitudes range from about 80 feet above sea level at the confluence of the Big Black and Mississippi Rivers to more than 500 feet along the eastern rim of the basin. The highest and most rugged terrain in the basin is found in the upper reaches of the eastern tributaries to the Big Black River. Generally, hills in the basin are well rounded and flood plains are wide.

Precipitation in the basin is heaviest during winter and spring, and the average annual amount is 52 inches. Average annual temperature is 65°F; freezing temperatures seldom last more than a day or two and days having temperature maximums of 100°F or more are unusual.

Canton (population 9,707) is the largest city in the basin. The economy is predominantly agricultural; industrial plants in the area are small to medium in size but contribute substantially to the economy of the basin.

GEOLOGIC AND WATER-RESOURCES INVESTIGATIONS IN AREA

Thirty-three publications listed in the bibliography describe, with varying degree of detail and emphasis, the geology and water resources of parts or all of the Big Black River basin and adjacent areas. Current (1966) water-resources investigations by the U.S. Geological Survey include a

EXPLANATION

●

Water well for which chemical analysis is in table 2. Water well numbers are assigned within a county by township-size lettered grid and a number.

⊙

Oil test shown on geohydrologic section (fig. 2). Oil test numbers are assigned numerically within counties.

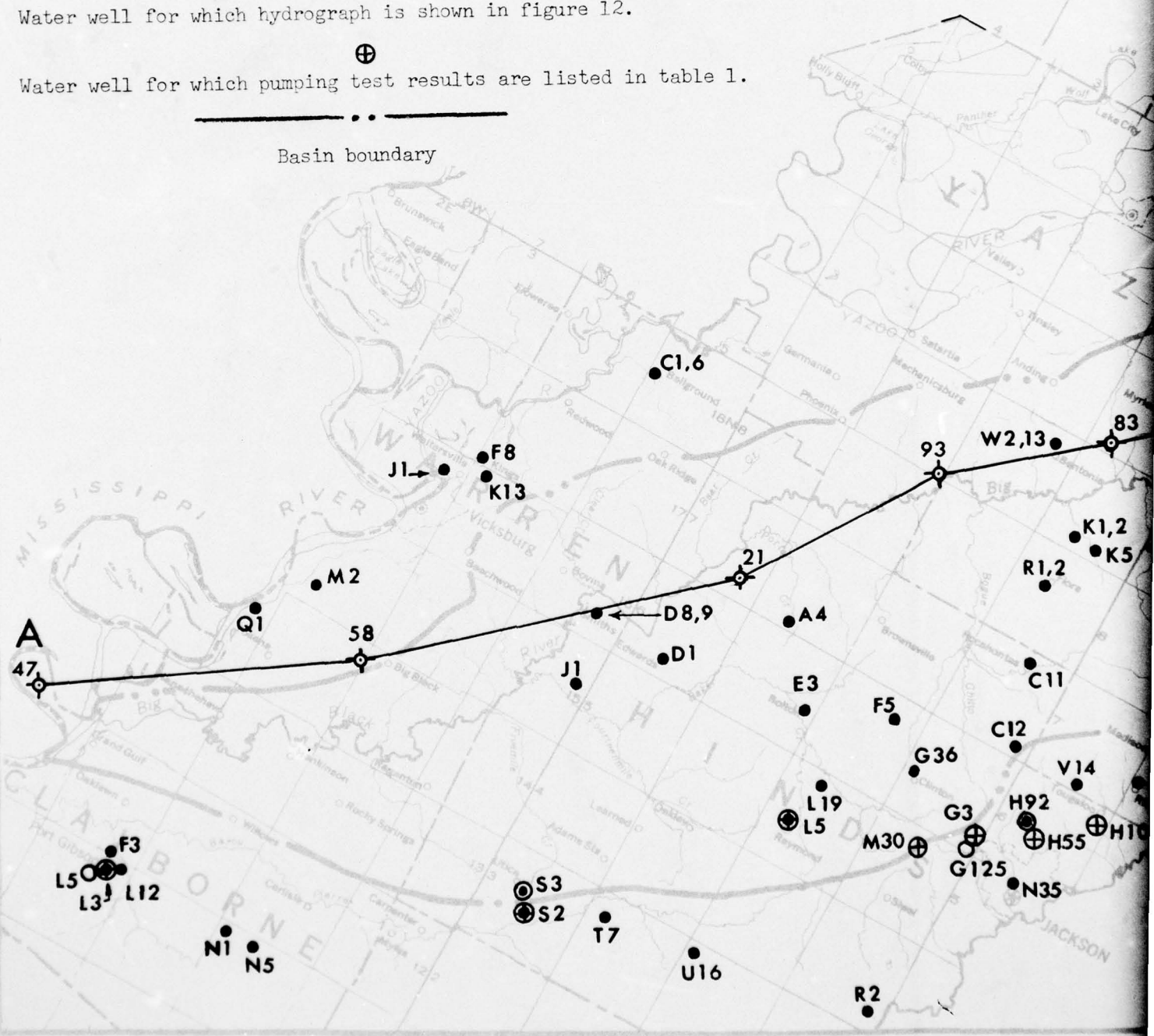
○

Water well for which hydrograph is shown in figure 12.

⊕

Water well for which pumping test results are listed in table 1.

Basin boundary



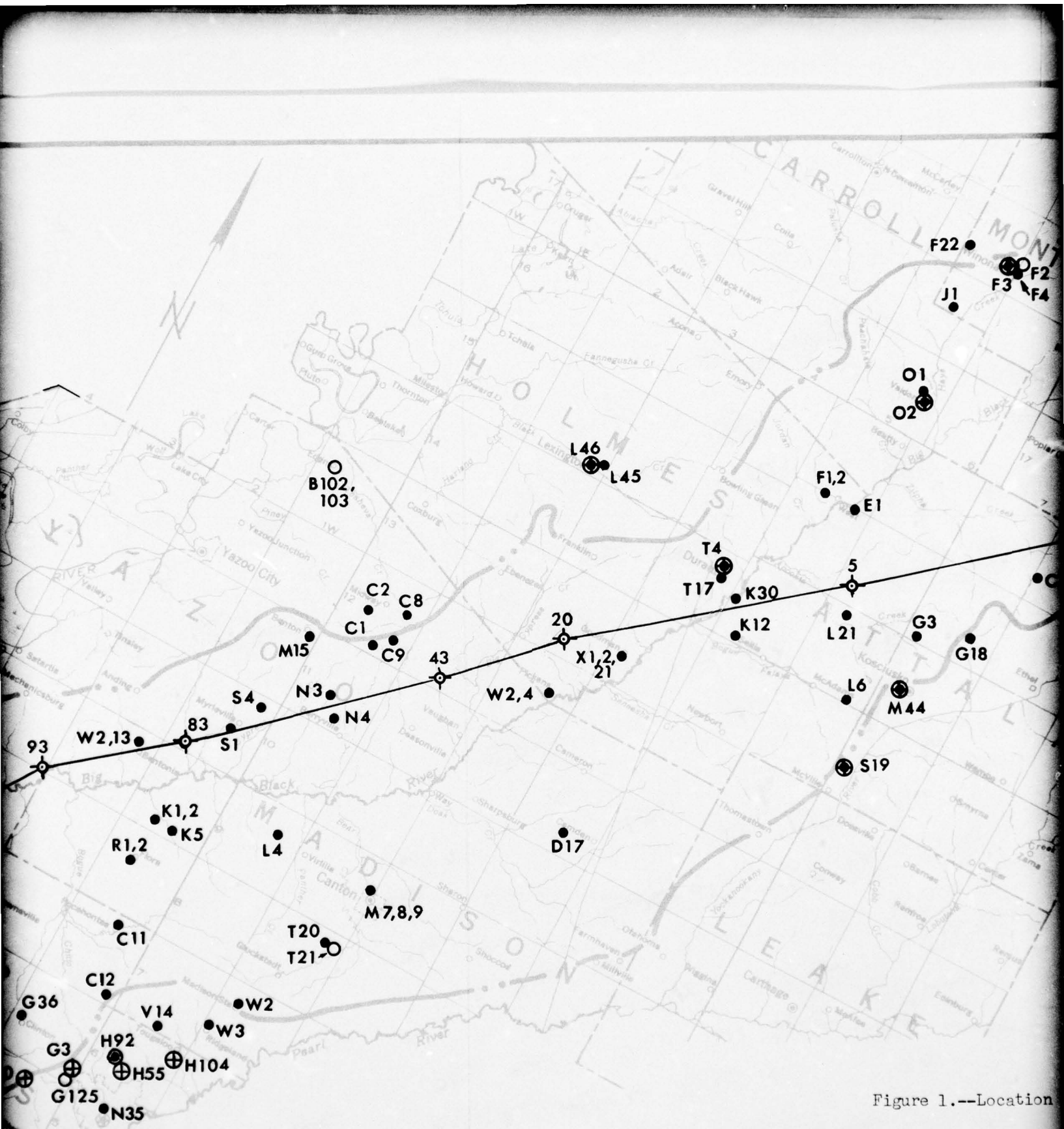


Figure 1.--Location

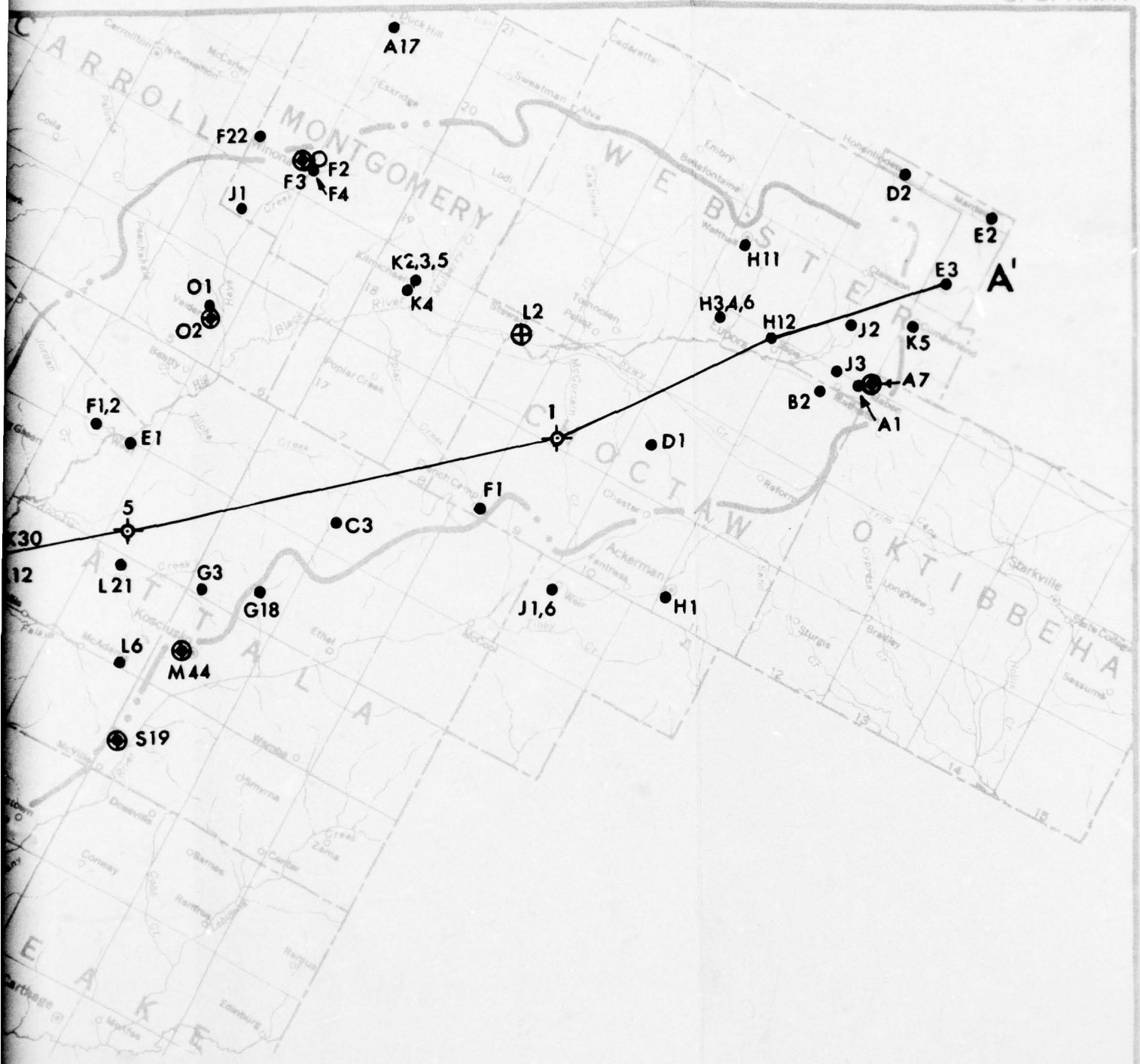


Figure 1.--Location of selected wells and oil tests, Big Black River basin, Mississippi.

study in the Jackson area, a study of the Mississippi embayment, low flow in the Big Black basin, and statewide collection of basic data.

SUMMARY OF GEOLOGY

The Big Black River basin is in the south-central part of the Mississippi embayment, a downwarped extension of the Gulf Coastal Plain. The beds of sediment filling the Mississippi embayment are underlain by consolidated rocks of Paleozoic age. The Paleozoic rock is about 2,500 feet below land surface at the northeast end of the Big Black basin and slopes southwestward at about 80 feet per mile toward the trough of the embayment, which lies generally under the Mississippi River.

The sediment filling the Mississippi embayment trough consists mostly of clay, shale, silt, sand, and gravel, and ranges in age from Jurassic to Quaternary; however, most of the units that are of interest to water users in the basin are of Tertiary age. The belts of outcrop of the Tertiary formations (fig. 13) are, in general, transverse to the course of the Big Black River.

From the outcrops the formations dip southwestward about 30 feet per mile. Down the dip, the formations increase in thickness and usually the rates of dip increase. The dips and thicknesses of the formations are locally affected by several large and many small structural features in the area. The larger structures are partially delineated by contour irregularities (figs. 3-6).

GROUND WATER

Occurrence

A geologic section along the axis of the Big Black River basin (fig. 2) shows the occurrence and availability of ground water in the basin. On the section the geologic units are named and the aquifers are identified (aquifers in the basin are beds of saturated sand or gravel that will yield water to wells). Lithologic characteristics of the units are briefly stated on the section and more details can be seen in the electrical logs shown. The characteristics of several of the units that are not aquifers are consistent over large areas. Some of these non-aquifers, or aquicludes, are the Yazoo Clay, Cook Mountain Formation, Zilpha Clay, Porters Creek Clay, and Selma Group. Some of the units containing aquifers have reasonably predictable lithologic characteristics over large areas. Among these are the Gordo, McShan, Eutaw, Meridian-upper Wilcox, Tallahatta, Winona, and Cockfield. Because of more lenticular deposition of sediments in the Wilcox, Sparta, Forest Hill, and Catahoula aquifer systems, it is more difficult to predict the thickness of sand beds, the percentage of sand, and the size and sorting of sand grains in these units. Capabilities of these last-named aquifer systems to yield water vary widely from place to place.

Not much is known about the alluvium in the lower part of the Big Black River flood plain, but it may be a good aquifer in places. With depth the alluvium usually grades from silt to sand and in places to gravel. Average depth of the alluvium above Bovina is about 25 feet. From Bovina downstream thickness of the alluvium probably increases and may be more than 100 feet near the mouth of the Big Black.

AD-A036 819 BIG BLACK RIVER BASIN COORDINATING COMMITTEE VICKSBU--ETC F/G 8/6
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY. VOLUME --ETC(U)
DEC 68

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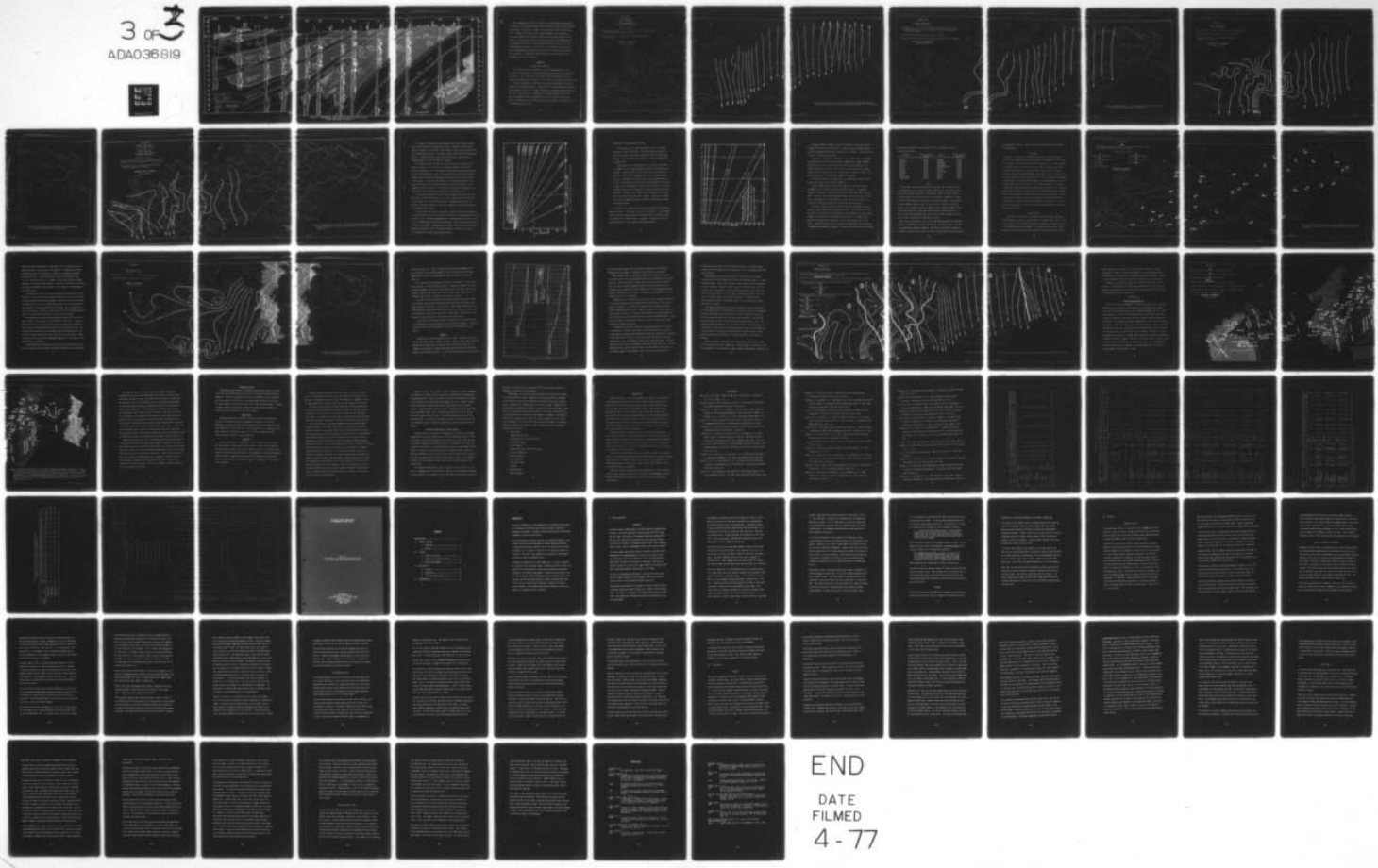

END

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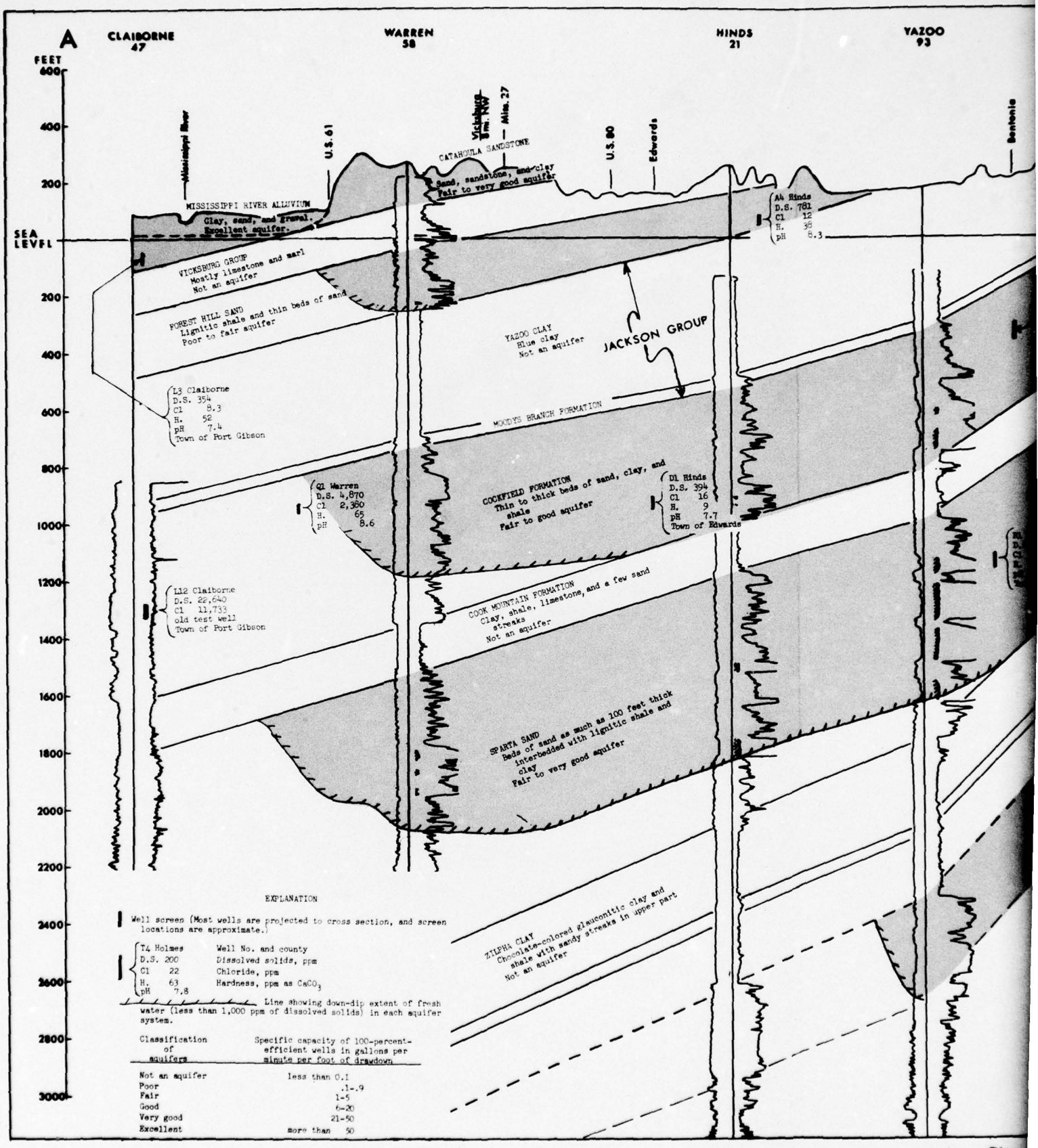

A
CLAIBORNE
47
WARREN
58
HINDS
21
YAZOO
93
FEET
SEA LEVEL
Mississippi River
U.S. 61
Vicksburg 8 mi. NW
Miss. 27
U.S. 80
Edwards
Bentonia
CATAHOULA SANDSTONE
Sand, sandstone, and clay
Fair to very good aquifer
MISSISSIPPI RIVER ALLUVIUM
Clay, sand, and gravel.
Excellent aquifer.
A4 Hinds
D.S. 781
Cl 12
H. 36
pH 8.3
VICKSBURG GROUP
Mostly limestone and marl
Not an aquifer
FOREST HILL SAND
Lignitic shale and thin beds of sand
Poor to fair aquifer
YAZOO CLAY
Blue clay
Not an aquifer
JACKSON GROUP
L3 Claiborne
D.S. 354
Cl 8.3
H. 52
pH 7.4
Town of Port Gibson
MOODYS BRANCH FORMATION
Q1 Warren
D.S. 4,870
Cl 2,360
H. 65
pH 8.6
COCKFIELD FORMATION
Thin to thick beds of sand, clay, and shale
Fair to good aquifer
D1 Hinds
D.S. 394
Cl 16
H. 9
pH 7.7
Town of Edwards
L12 Claiborne
D.S. 22,640
Cl 11,733
old test well
Town of Port Gibson
COOK MOUNTAIN FORMATION
Clay, shale, limestone, and a few sand streaks
Not an aquifer
SPARTA SAND
Beds of sand as much as 100 feet thick interbedded with lignitic shale and clay
Fair to very good aquifer
ZILPHA CLAY
Chocolate-colored glauconitic clay and shale with sandy streaks in upper part
Not an aquifer
EXPLANATION
Well screen (Most wells are projected to cross section, and screen locations are approximate.)
T4 Holmes — Well No. and county
D.S. 200 — Dissolved solids, ppm
Cl 22 — Chloride, ppm
H. 63 — Hardness, ppm as $CaCO_3$
pH 7.8
Line showing down-dip extent of fresh water (less than 1,000 ppm of dissolved solids) in each aquifer system.
Classification of aquifers
Specific capacity of 100-percent-efficient wells in gallons per minute per foot of drawdown
Not an aquifer — less than 0.1
Poor — .1-.9
Fair — 1-5
Good — 5-20
Very good — 21-50
Excellent — more than 50

Figu

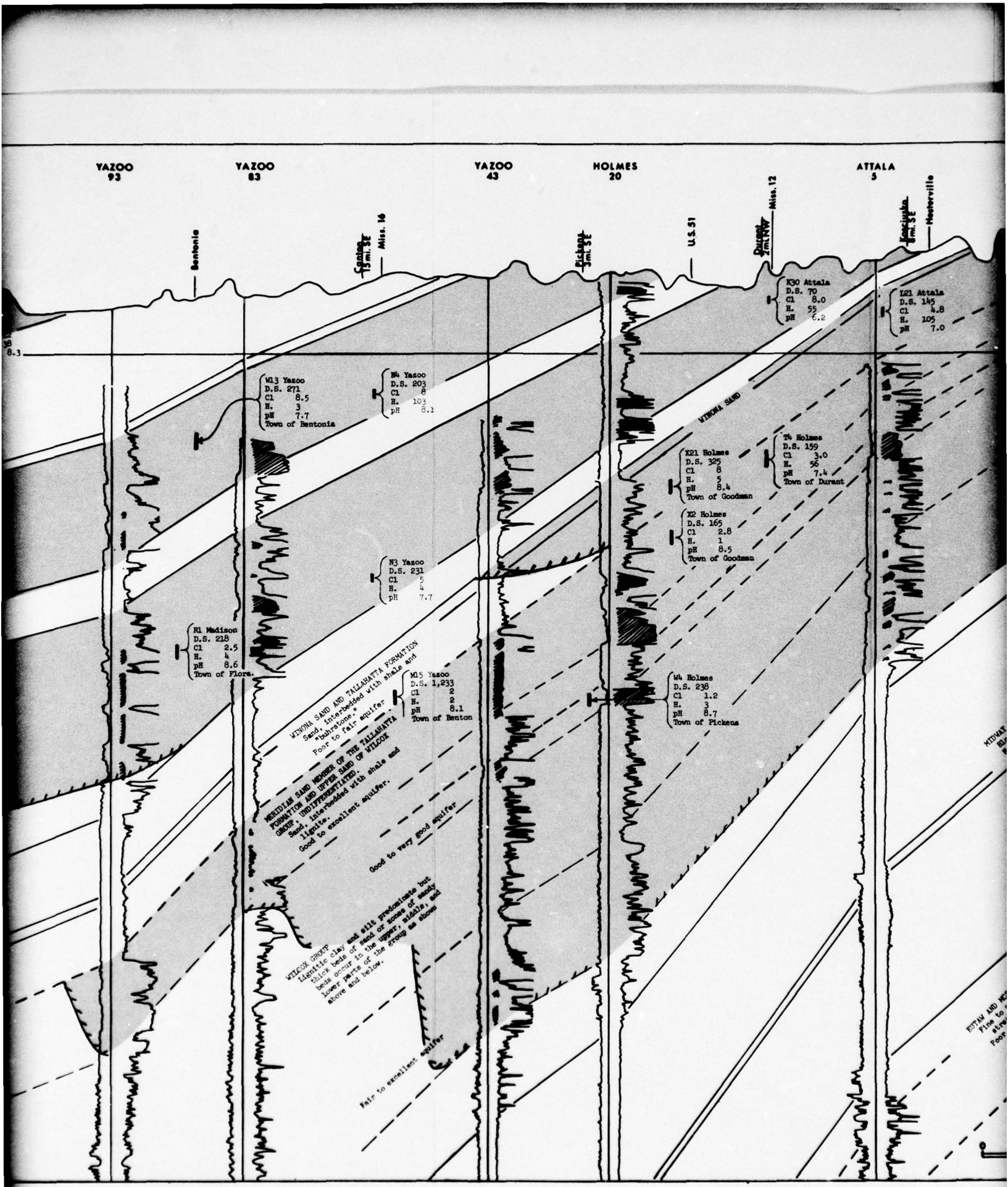
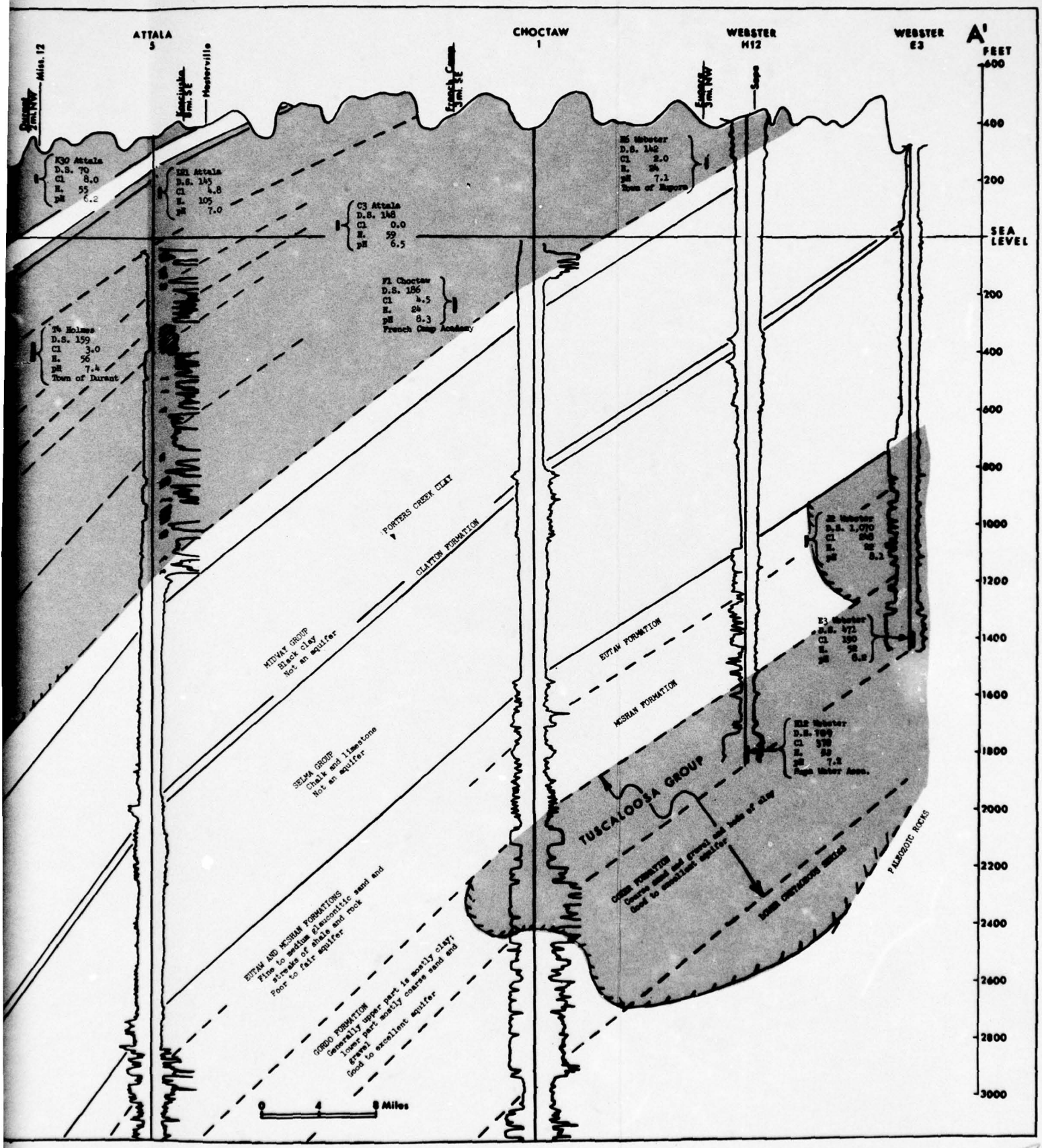


Figure 2.-- Geohydrologic section, Big Black River basin, Mississippi
(Line of section shown on figure 1).

2


ATTALA
5
CHOCTAW
1
WEBSTER
H12
WEBSTER
E3
A'
FEET
SEA LEVEL
Miles
K30 Attala
D.S. 70
Cl 8.0
H. 55
pH 6.2
K31 Attala
D.S. 145
Cl 4.8
H. 105
pH 7.0
C3 Attala
D.S. 148
Cl 0.0
H. 59
pH 6.5
H5 Webster
D.S. 142
Cl 2.0
H. 24
pH 7.1
Town of Eupora
F1 Choctaw
D.S. 186
Cl 4.5
H. 24
pH 8.3
French Camp Academy
T4 Holmes
D.S. 159
Cl 3.0
H. 56
pH 7.4
Town of Durant
PORTERS CREEK CLAY
CLAIBORNE FORMATION
MIDWAY GROUP
Black clay
Not an aquifer
SELMA GROUP
Chalk and limestone
Not an aquifer
EUTAW FORMATION
MOSHAN FORMATION
TUSCALOOSA GROUP
GRAVEL FORMATION
Coarse sand and gravel and beds of clay
Good to excellent aquifer
LOWER CRETACEOUS SERIES
PALEOZOIC ROCKS
EUTAW AND MOSHAN FORMATIONS
Fine to medium glauconitic sand and
streaks of shale and rock
Poor to fair aquifer
GORDO FORMATION
Generally upper part is mostly clay;
lower part mostly coarse sand and
gravel
Good to excellent aquifer
0
4
8 Miles

ppi

3

The geohydrologic section is one aid in locating water-bearing sands. In addition, several structure maps have been drawn showing the configuration and altitude of the bases of seven of the principal aquifer systems (figs. 3-6). Formation thicknesses in the basin generally do not change much along the strike, which is nearly transverse to the geohydrologic section (fig. 1). The depth of a well in a selected aquifer can be determined by (1) plotting the location on the appropriate structure contour map, (2) determining the altitude of the base of the aquifer system at that point, and (3) algebraically applying this altitude to the land surface altitude at the locality. (Topographic maps showing land surface altitude are available for most of the basin.)

Quantity

Aquifer Characteristics

The quantity of water available to a well depends basically on the size and interconnection of the void space between grains of sand composing the aquifer. The size, shape, and sorting of the grains affect the void space and consequently the capacity of the aquifer to store and transmit water.

Aquifers underlying the Big Black River basin differ greatly in their capacity for transmitting water. Coefficients of transmissibility determined from pumping tests (table 1) ranged from 4,800 to 85,000 gpd (gallons per day) per foot. The coefficient of permeability (transmissibility divided by aquifer thickness in feet) ranged from 60 to 1,550 gpd per square foot. All the pumping tests were of artesian aquifers and most of the coefficients of storage were near 0.0001.

EXPLANATION

- - - - -200- - - -

GORDO FORMATION

———— -200 ————

Lower sand of Wilcox Group

Structure Contour

Shows altitude of base of the aquifer system. Contour interval 200 feet. Datum is mean sea level.

Structure contours of Wilcox are from unpublished map by E. H. Boswell.

———— • • ————

Basin boundary

Figure 3.—
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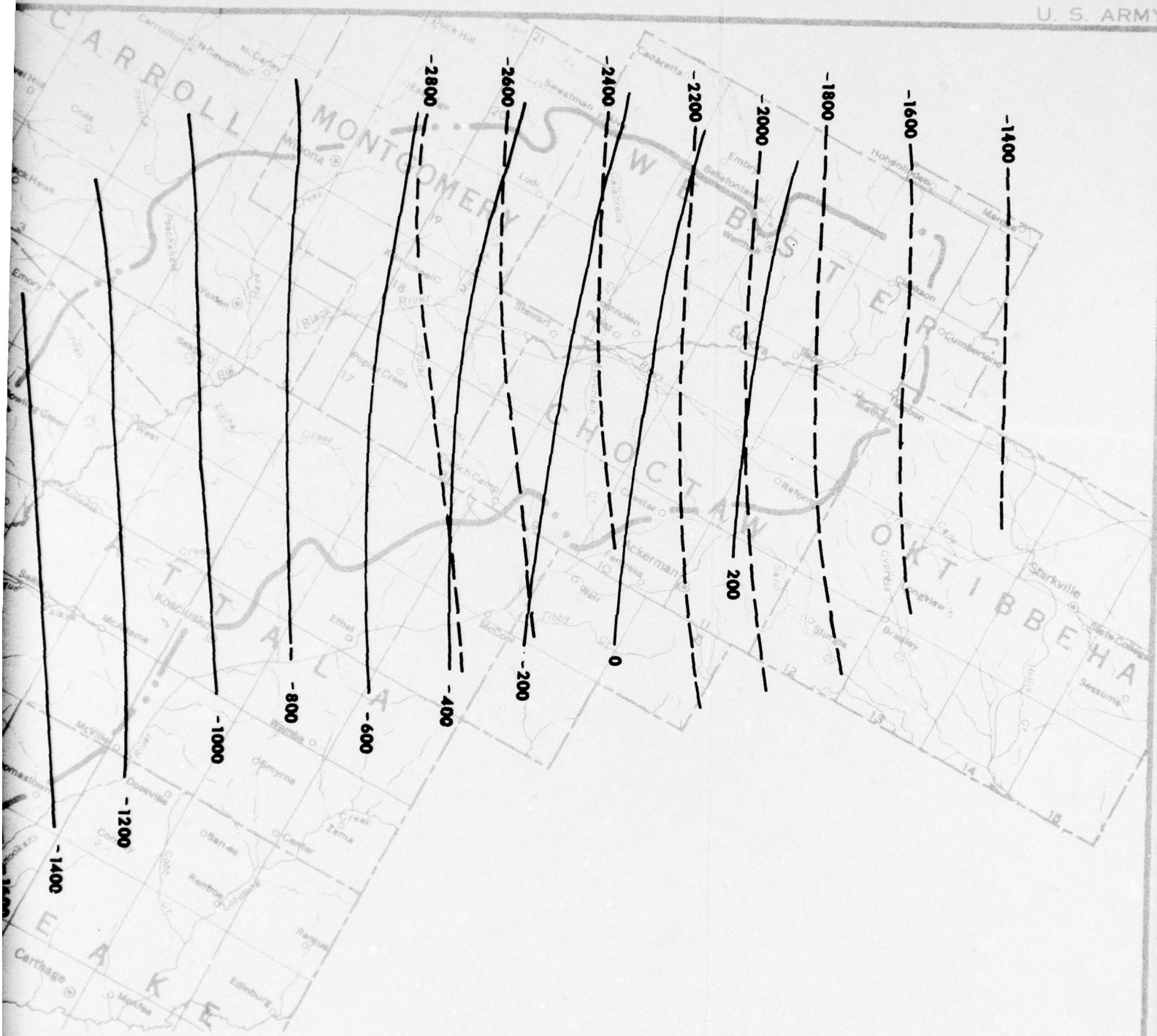


Figure 3.--Structure map of two of the aquifer systems--Gordo Formation and lower sand zone of Wilcox Group--Big Black River basin, Mississippi.

3

EXPLANATION

-200

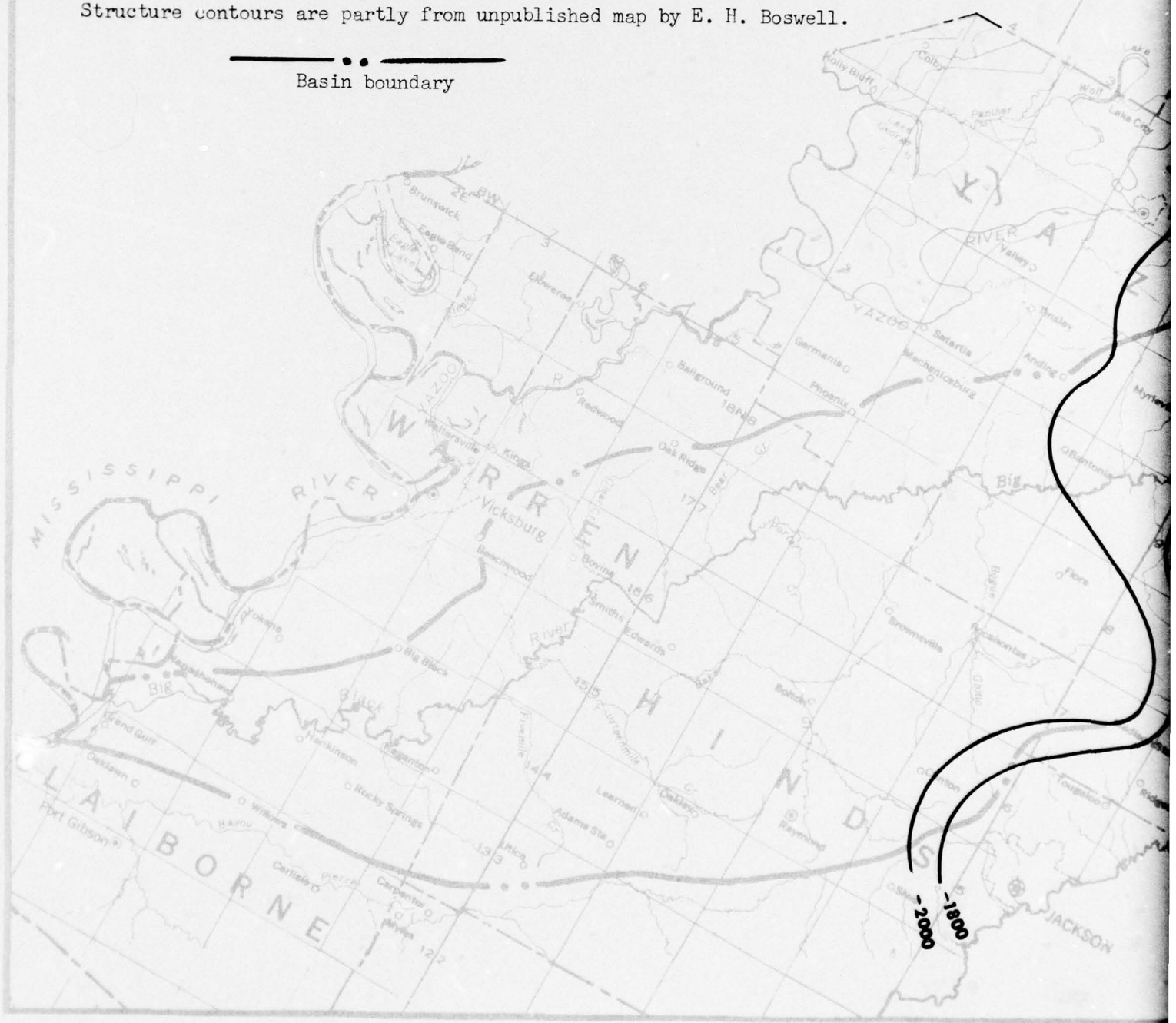
Structure Contour

Shows altitude of base of the Meridian-upper Wilcox aquifer system. (Meridian Sand Member of the Tallahatta Formation-upper sand of the Wilcox Group).

Contour interval 200 feet; datum is mean sea level.

Structure contours are partly from unpublished map by E. H. Boswell.

Basin boundary



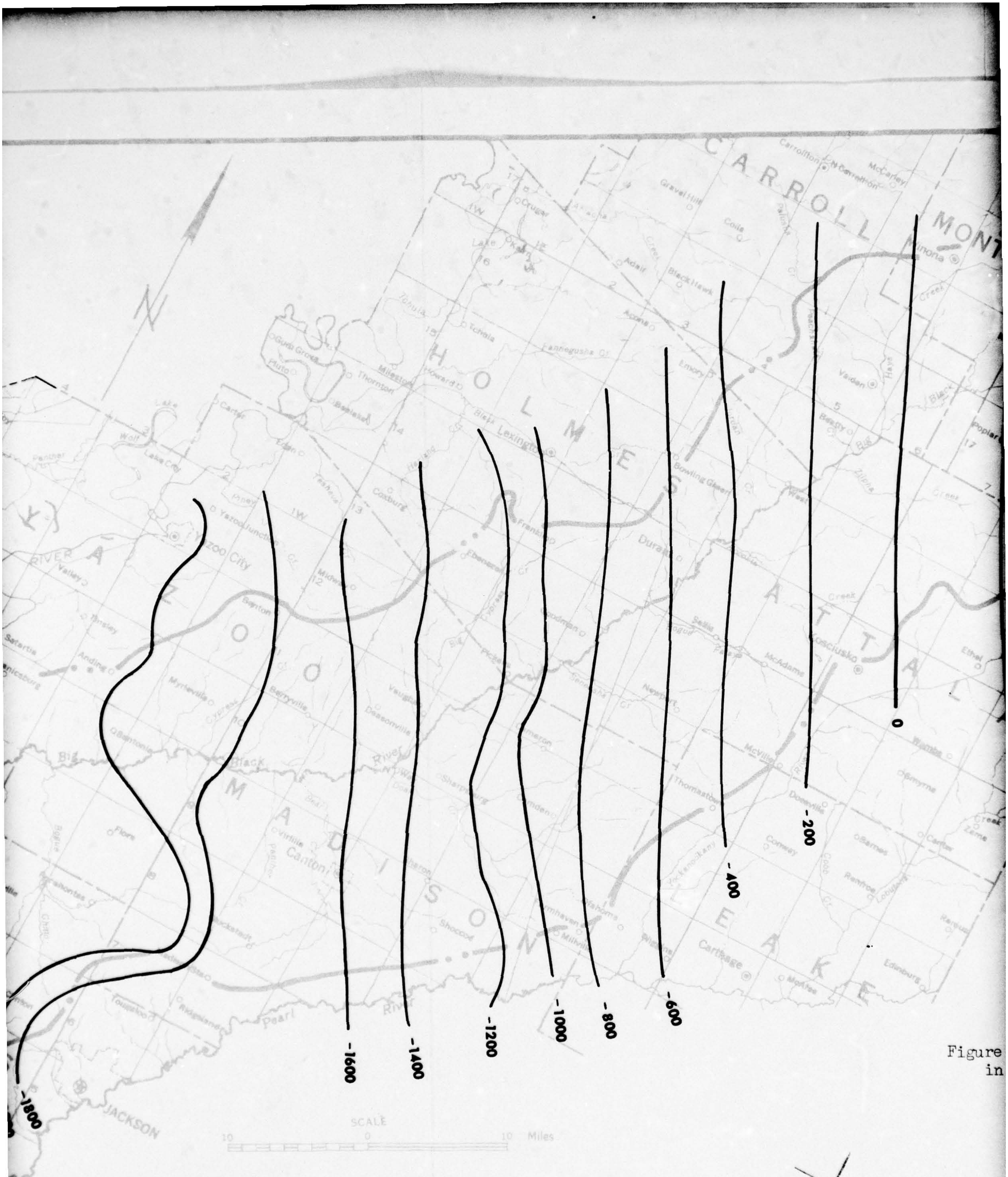

N
CARROLL
MONT
HOLMES
ATTALA
YAZOO
MADISON
LEAKE
RIVER
JACKSON
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
-1800
SCALE
10 0 10 Miles

Figure
in

2

Figure 4.--Structure map of the Meridian-upper Wilcox aquifer system in the Big Black River basin, Mississippi.

EXPLANATION

——— -200 ———
Structure contour

Shows altitude of base of the Sparta Sand aquifer system.

Contour interval 200 feet; datum is mean sea level.

Structure contours are partly from unpublished map by E. H. Boswell.

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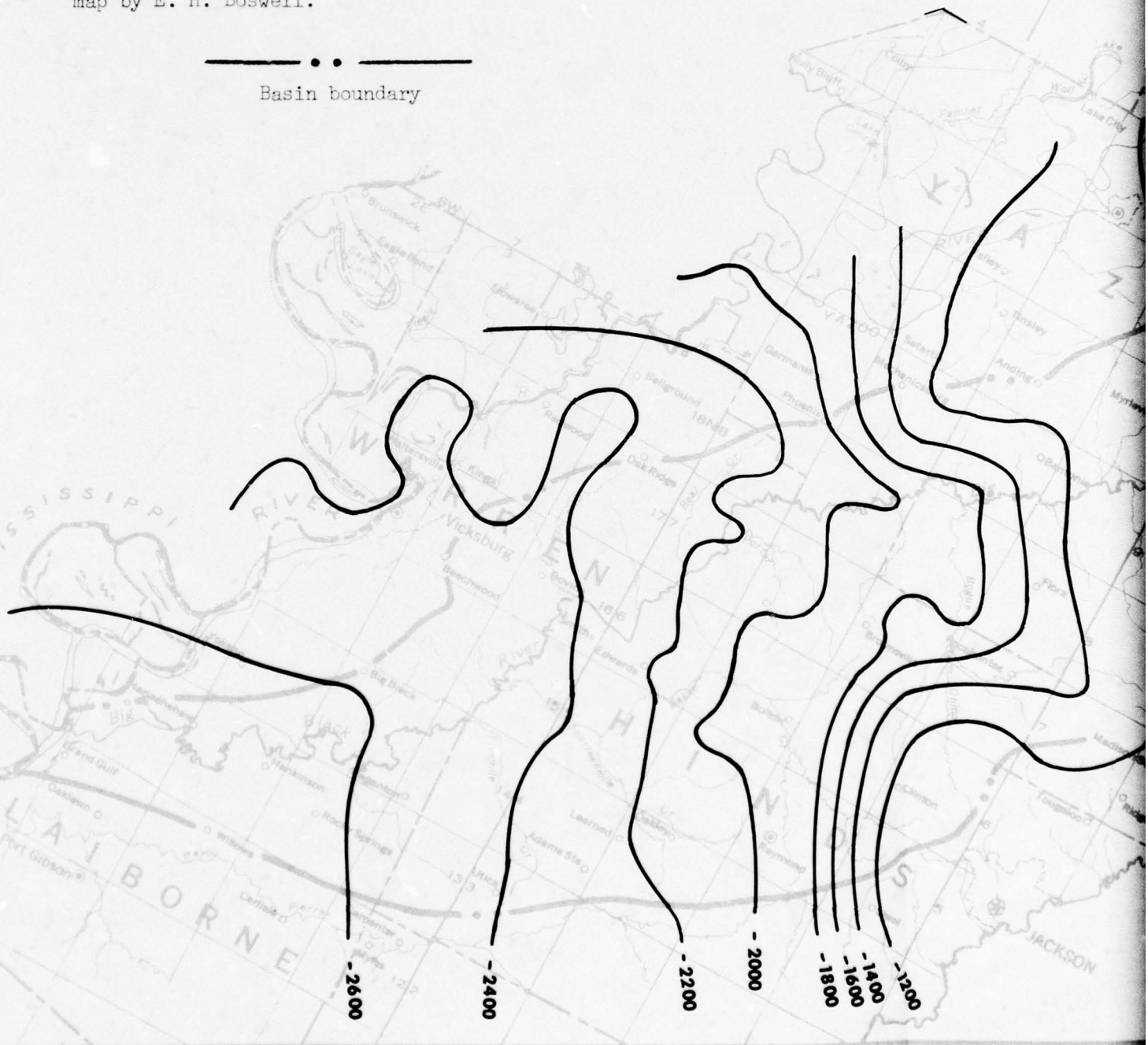
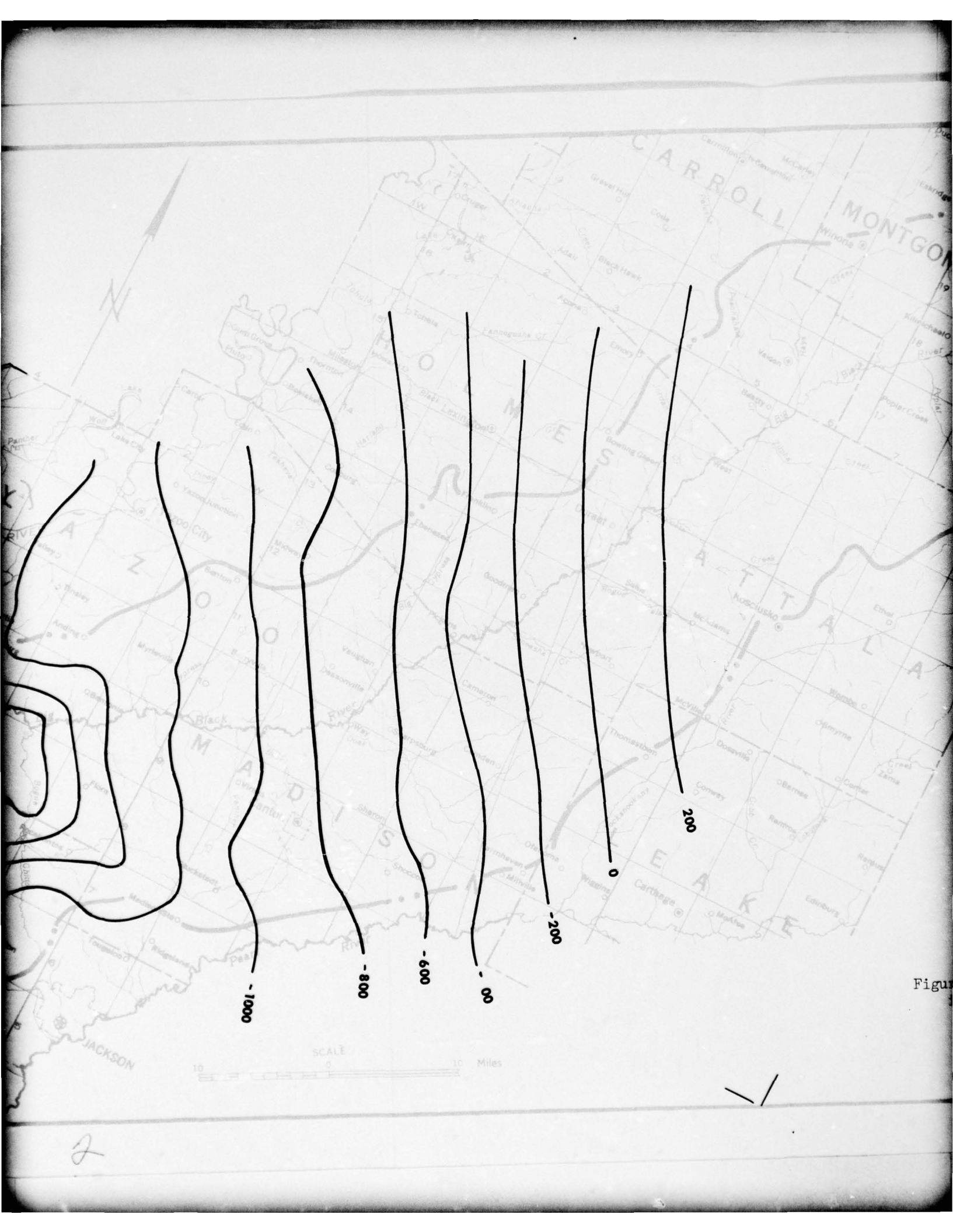
Basin boundary





Figur

Figure 5.--Structure map of the Sparta Sand aquifer system in the Big Black River basin, Mississippi.

CORPS OF ENGINEERS

EXPLANATION

-200

Cockfield Formation

-200

Forest Hill Sand

-200

Catahoula Sandstone

Structure contour

Shows altitude of the base of the aquifer system. Contour interval 200 feet; datum is mean sea level.

Structure contours of Cockfield are partly from unpublished map by E. H. Boswell.

Basin boundary

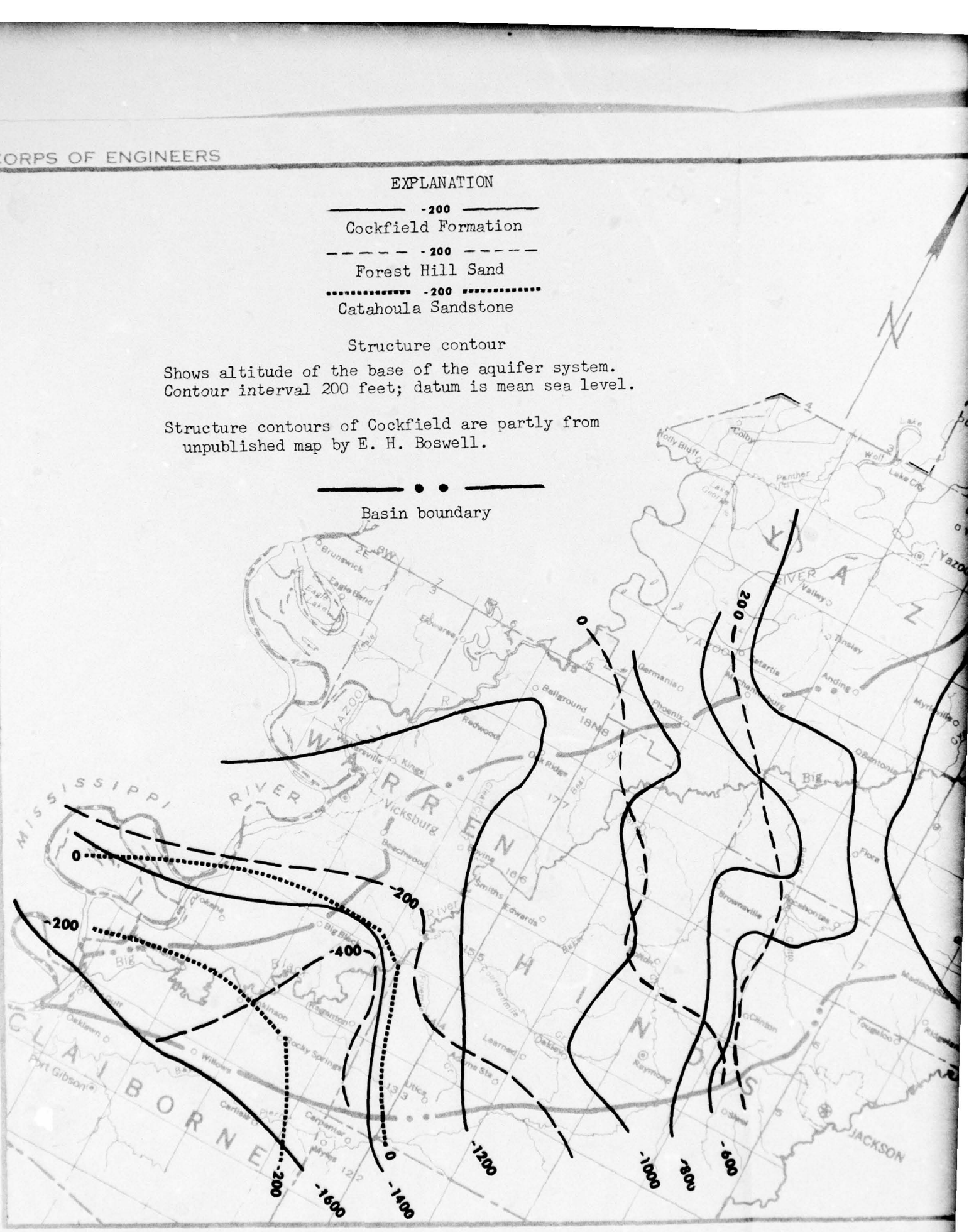


Figure 6.—
Forest
Missis

Figure 6.--Structure map of three of the aquifer systems—Cockfield Formation, Forest Hill Sand, and Catahoula Sandstone-in the Big Black River basin, Mississippi.

The ranges of permeability and transmissibility are probably greater than is indicated by the pumping test results. Certainly, some domestic wells are screened in thin beds of fine sand that have very low permeability and transmissibility values. The Coker, Gordo, lower Wilcox, Meridian-upper Wilcox, and Sparta aquifer systems each probably has a coefficient of transmissibility of more than 85,000 at places.

The amount of water that can be obtained from a well depends on the specific capacity of the well and the available drawdown in the well. Specific capacity of a well (the number of gallons of water per minute that the well will produce for each foot of drawdown after a specified period of pumping) reflects both the efficiency of the well and the characteristics of the aquifer. Well efficiency depends on design and development of the well; a few wells are 100-percent efficient, but most fall short of that standard for various reasons. The specific capacities of 100-percent efficient wells vary as the transmissibilities of the aquifers vary.

The available drawdown in a well is the distance from the static water level down to some limiting point, such as the bottom of the pump, the top of the screen, or a point calculated using a designated water lift. The product of available drawdown and specific capacity is the maximum production to be expected from a well.

The practical application of measured or assumed aquifer characteristics is in predicting the yields of wells and the effects of ground-water withdrawal. A graph (fig. 7) relating transmissibility to drawdown and well yield is useful in estimating well yields and pump settings. Many of the sand beds listed in table 1 are capable of maintaining well yields in excess of the 2,500-gpm (gallons per minute) limit of the graph; however, no wells in the basin are constructed to supply more than that amount.

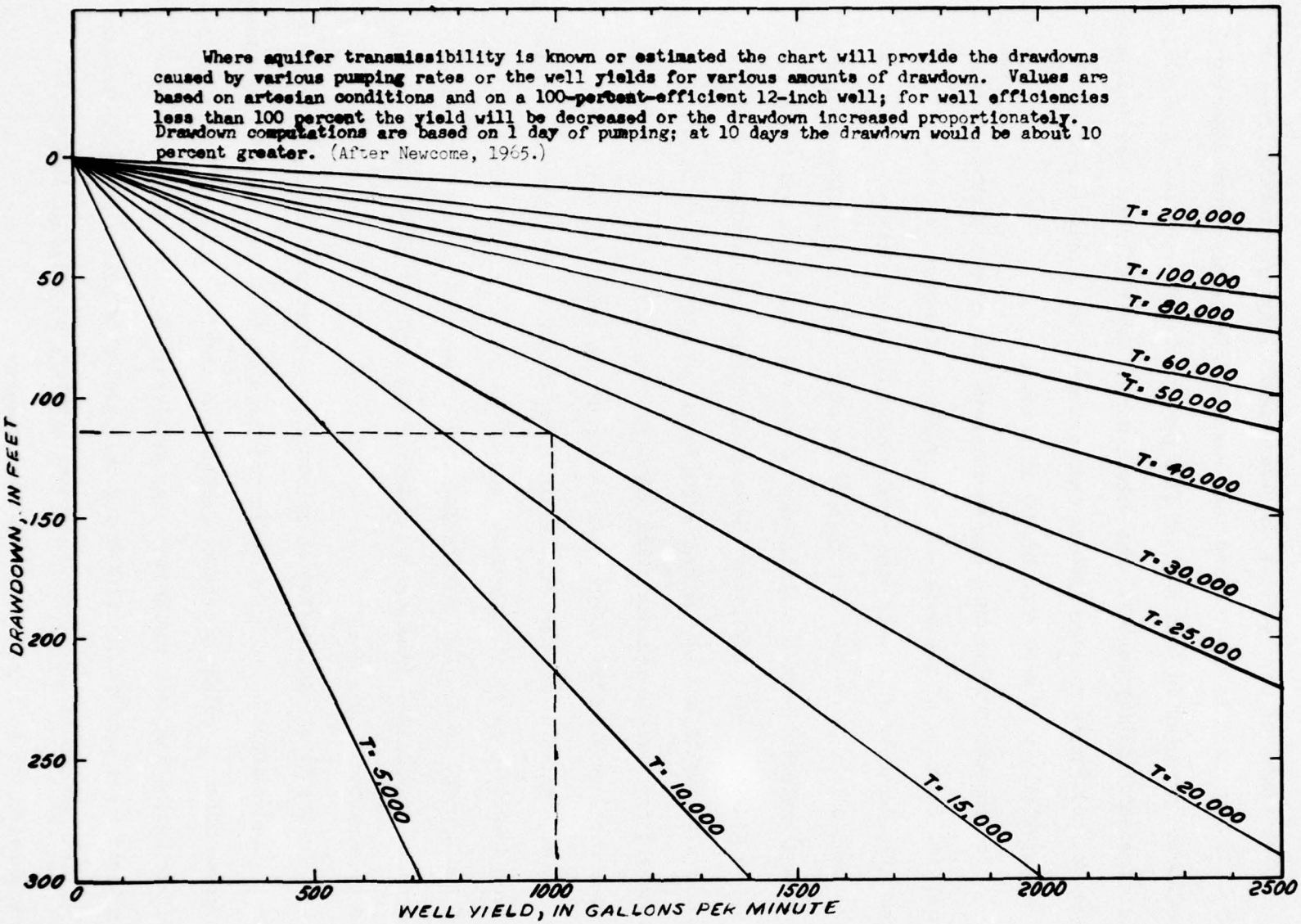


Figure 7.--Transmissibility - drawdown - well yield relationship.

An example of the graph's use follows:

An electric log of a test hole showed a 40-foot thickness of sand at a depth of 500 feet. From other wells tapping that aquifer the static water level is known to be 50 feet below land surface. How deep should a pump be set to supply 1,000 gpm from a 12-inch well?

Estimating that the permeability of the aquifer is 500 gpd per square foot, the transmissibility would be 20,000 gpd per foot (40x500). Using the graph, the T=20,000 line crosses the 1,000 gpm line at the 115-foot drawdown line. As the static level is 50 feet, a drawdown of 115 feet would place the pumping level at 165 feet. This assumes a 100-percent-efficient-well--one in which no head is lost in movement of water from the aquifer into the well. A fully efficient well is atypical; 75-percent efficiency is more realistic. Therefore it is likely that a pumping level of nearly 200 feet would be required in this example. Of course, any deviation from the assumed permeability or well efficiency will affect the drawdown value.

The effect that pumping the above well would have on the artesian pressure surface for the aquifer can also be predicted. A second graph (fig. 8) relates transmissibility and drawdown effect at various times and distances for a selected rate of pumping. This graph is useful in guiding decisions on well spacing and withdrawal rates.

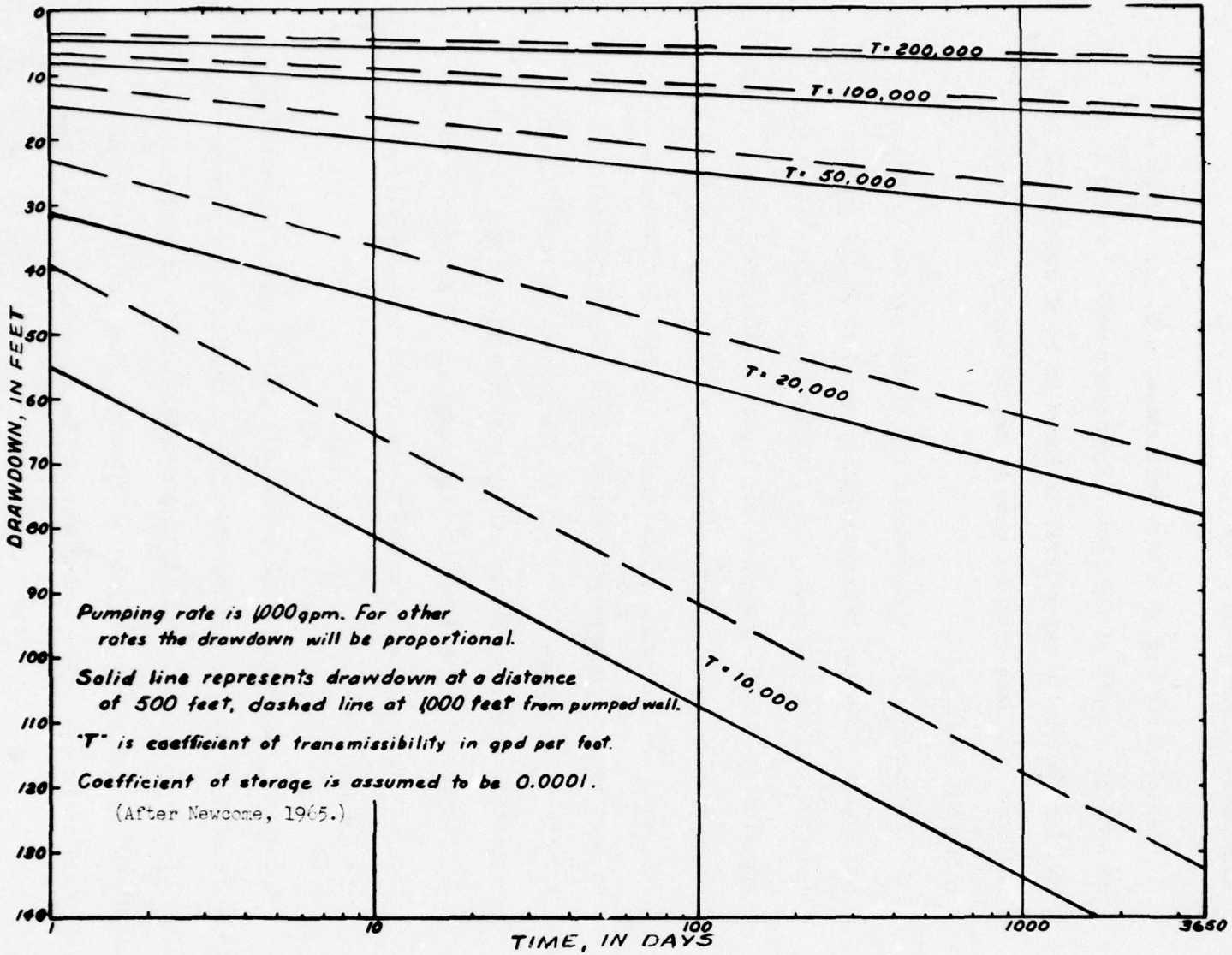


Figure 8.--Time-drawdown relations for selected aquifer characteristics.

Using the graphs of figures 7 and 8, the amount of water that can be obtained from an aquifer in an area of a specified size and shape and with a specified maximum drawdown may be predicted. An example of this prediction is given in the following problem:

Situation: A square plot 1,000 feet on a side (23 acres) is available for installation of a well field needed to supply about 13 mgd. Maximum pumping depth should be no lower than 300 feet below land surface. An aquifer available at a depth of 500 feet has a coefficient of transmissibility of 50,000 gpd per foot and a coefficient of storage of 0.0001. The static water level is 20 feet below average land surface.

Information desired: How many wells are needed, what should be their pumping rate, and how should they be spaced?

Answer: Eight fully efficient wells pumped at 1,125 gpm each and arranged around a 1,000-foot square on 500-foot centers. The greatest drawdown at the end of one year would be 274 feet (294 feet below land surface). This well field would supply 12.95 mgd. Water levels will be drawn down substantially in the area adjacent to the well field; however, the effects will decrease as distance from the well field increases.

The above example is an isolated well field in an idealized artesian aquifer; actual conditions are usually different. At most places more than one aquifer is available, which makes more water available than shown in the example. On the other hand, less water than shown in the example may be available if significant interference is felt from distant wells or well fields. Based on available data on aquifer characteristics and thicknesses of aquifers and assuming a drawdown to a depth of 300 feet below land surface,

ground water available within five miles of the following locations is estimated as follows:

Locality	Million gallons per day	Locality	Million gallons per day
Benton	25-50	Goodman	25-50
Bentonia	25-50	Jackson	10-25
Bolton	10-15	Kilmichael	10-25
Bovina	10-15	Kosciusko	10-25
Canton	25-50	Maben-Mathiston	10-15
Clinton	10-15	Madison	10-25
Durant	25-50	Pickens	25-50
Edwards	10-15	Port Gibson	10-15
Eupora	10-15	Utica	10-25
Flora	10-25	Vaiden	10-25
French Camp	10-15	West	10-25
Grand Gulf	10-50	Winona	10-15

Wells

Practically all wells more than 100 feet deep are rotary drilled and are artesian--that is, the water is under pressure and rises above the top of the aquifer when the aquifer is penetrated. Depths of water wells in the basin range from less than 10 feet to 2,400 feet. Diameters of casing in drilled wells range from 2 inches to more than 20 inches. In most wells a larger diameter casing is used in the top part of the well than in the bottom. Various types, sizes, and lengths of well screen are used to hold the aquifer material in place while allowing water to enter the well. A pack of gravel placed between the screen and the aquifer commonly is used in an effort to increase the efficiency of a well.

Most wells are pumped at rates of less than 500 gpm (gallons per minute); however, a few produce more than 1,000 gpm and some could produce more than 2,000 gpm without excessive drawdown. Over most of the basin it should be possible to construct wells that will produce 2,000 gpm from the best aquifer

underlying the locality. At most places several aquifers are available for development.

Water Use

Water use is light in the Big Black River basin, since the region is neither heavily populated nor industrialized. Practically all of the domestic, municipal, and industrial water is from wells, as is a small quantity of irrigation water. Canton, the largest city in the basin, used about 0.75 mgd (million gallons per day) in 1960. Winona is not as large as Canton but, owing to industrial demand, used about 1 mgd. No other city in the basin pumped more than 0.5 mgd (fig. 9). Total ground-water withdrawal, including water from many unused flowing wells, was probably not more than 10 mgd in 1960 and 11 mgd in 1965. In some areas adjacent to the basin, ground-water withdrawal in 1960 was comparatively heavy (fig. 9) with Jackson using 10 mgd, Yazoo City using 8 mgd, and Kosciusko using 2 mgd. (Pumpage from the Sparta Sand at Jackson and Yazoo City is shown on figure 9 because it affects the movement of water in the aquifer in the Big Black basin; a large amount of pumpage from the Mississippi River alluvium at Yazoo City is not shown because it has no effect on ground-water movement and availability in the basin.)

Water Levels

Water-level fluctuations in an aquifer reflect recharge, discharge, water movement, and aquifer characteristics. Recharge raises water levels most in the area of recharge; conversely, discharge lowers water levels most in the immediate area of discharge. Ground water moves from areas where water levels are high to areas where water levels are low (seeps, springs,

EXPLANATION

▲85

Aquifer symbol showing location of water use and number showing thousands of gallons per day used in 1960.

Aquifer system symbols

△ Catahoula Sandstone

■ Cockfield Formation

○ Sparta Sand

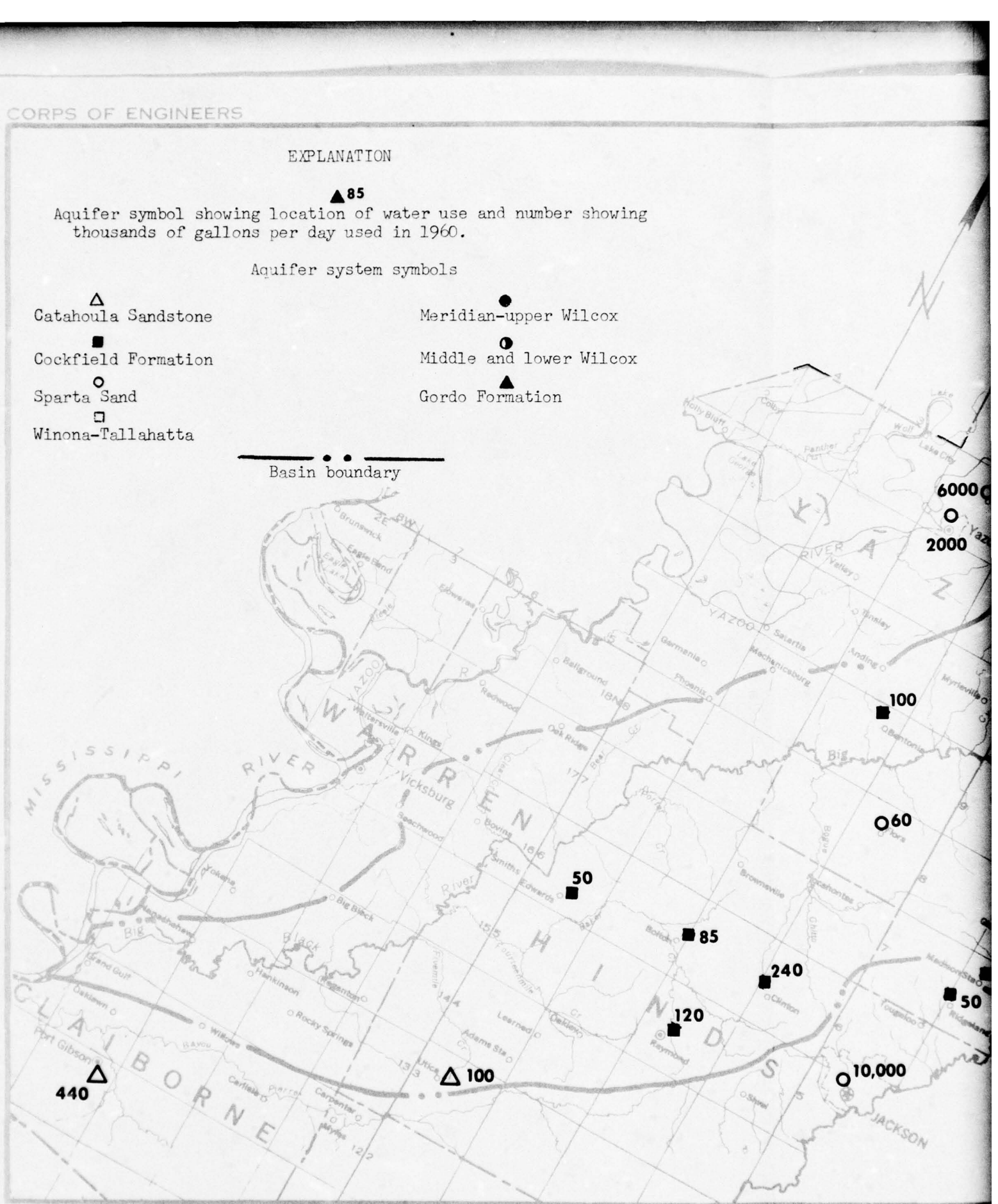
□ Winona-Tallahatta

● Meridian-upper Wilcox

◑ Middle and lower Wilcox

▲ Gordo Formation

Basin boundary



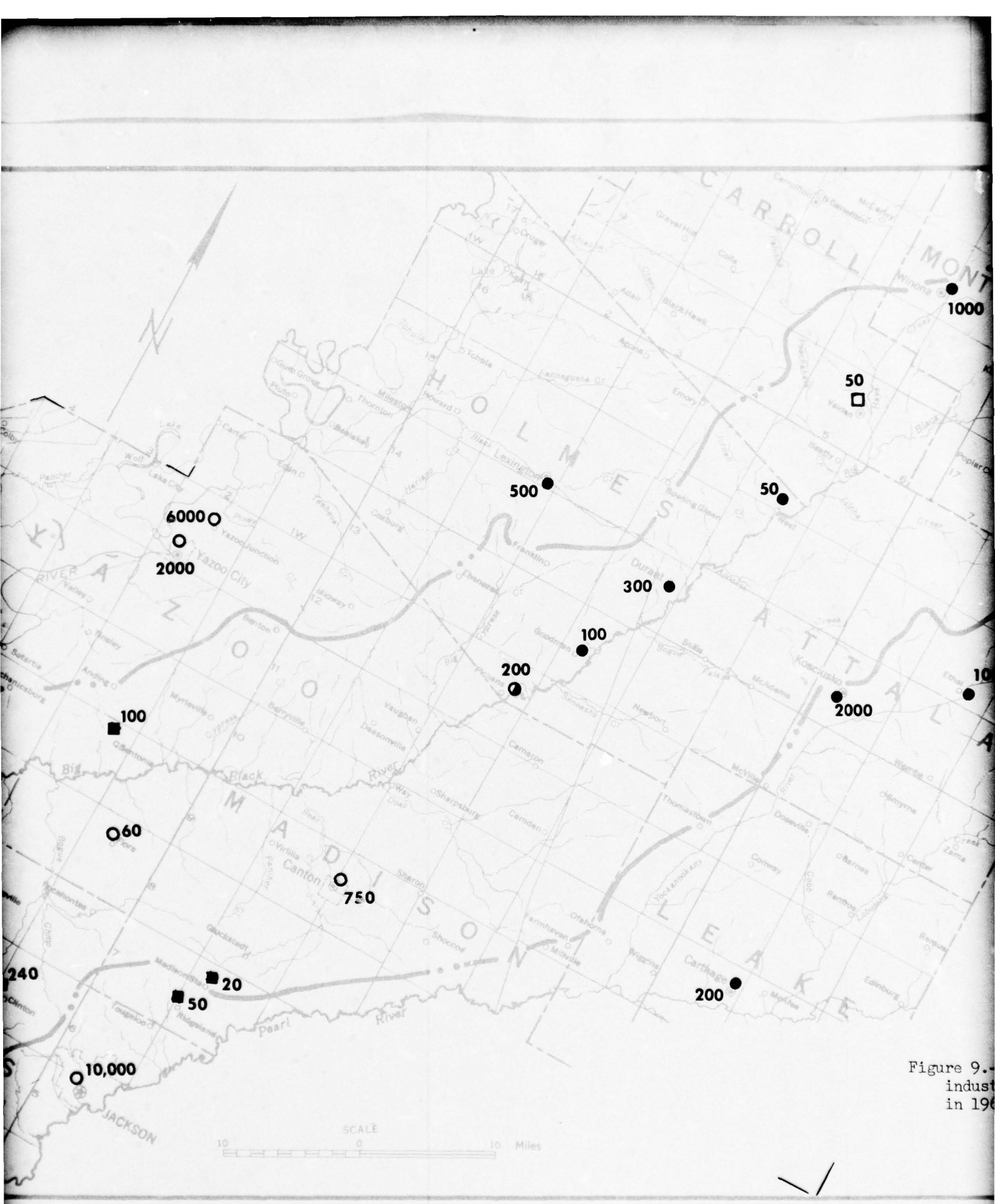


Figure 9.-
indust
in 196

Figure 9.--Map showing quantity and source of water pumped by public and industrial water systems in the Big Black River basin, Mississippi in 1960.

wells, or leaky confining beds). The amount of flow between two points depends directly on the ability of the aquifer to transmit water (transmissibility) and on the difference in water level (hydraulic gradient) between the points. A map showing water levels in an aquifer system (fig. 10) shows the direction of movement of water and reflects recharge, discharge, and aquifer characteristics. Spacing of contour lines indicates the hydraulic gradient; water movement is down gradient at right angles to the contour lines.

A water-level contour map of the Sparta Sand aquifer system is representative of the various aquifer systems underlying the basin, except that the Sparta system is more heavily pumped. Water levels in all the systems are higher in the outcrop (recharge) areas and lower to the southwest and west in areas of natural and artificial discharge. All the aquifers are full and overflow to streams in outcrop areas (fig. 13) through springs and seeps. The ground water overflow is the base flow of streams.

Most ground-water levels along the Big Black stand within 30 feet of, above or below, the altitude of the flood plain of the river. However, in the upper part of the basin the water levels in aquifers older than the Wilcox Group usually are almost 200 feet below flood-plain altitude. On the other hand, water levels in the deeper aquifers underlying the lower third of the basin may be more than 30 feet above the flood plain. Depth to water in wells located in the highlands generally is less than 100 feet below the tops of the wells.

Heavy pumpage from the Sparta Sand aquifer at Jackson and Yazoo City (fig. 9) causes the two prominent depressed areas shown on the water-level

EXPLANATION

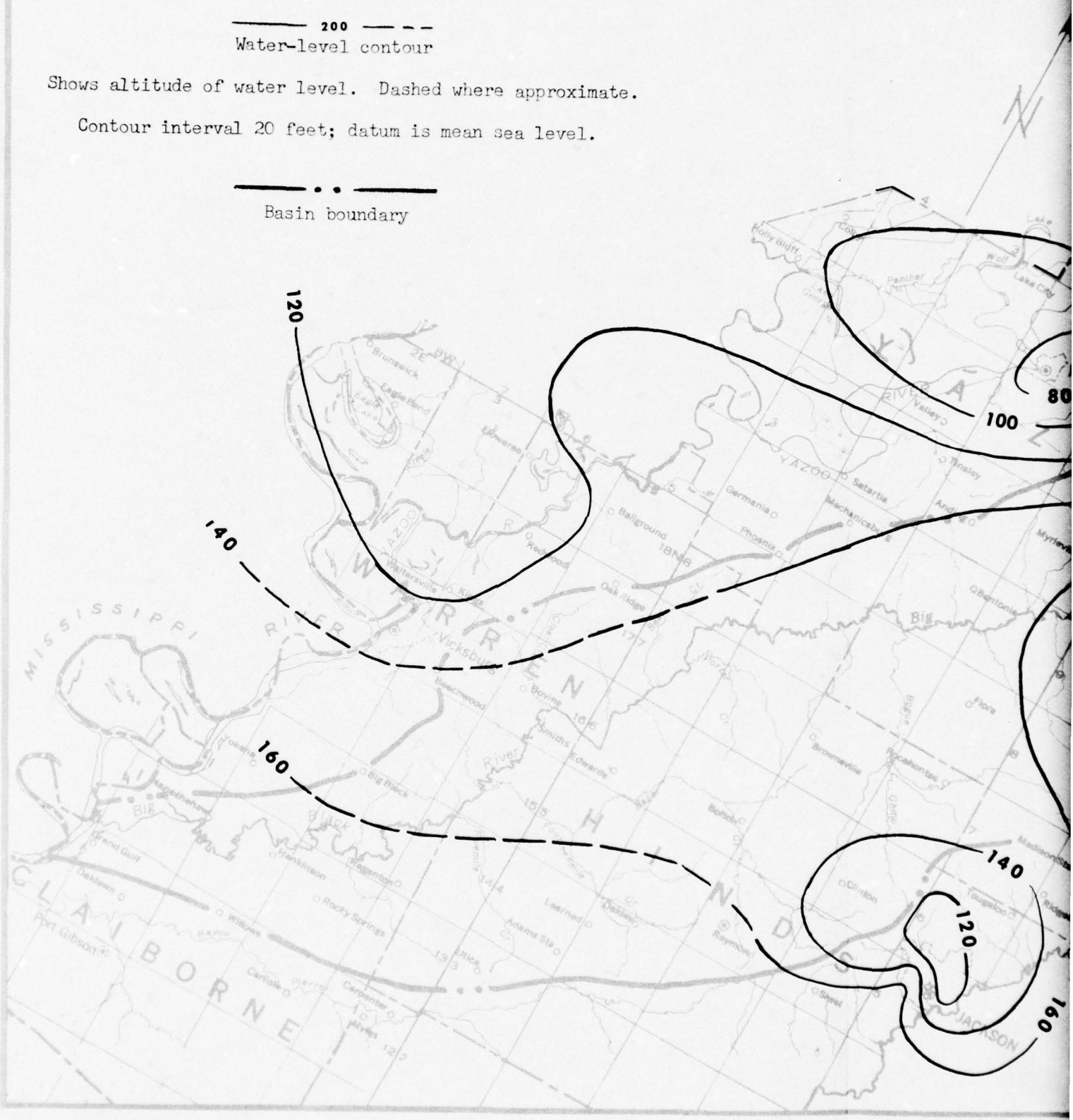
200

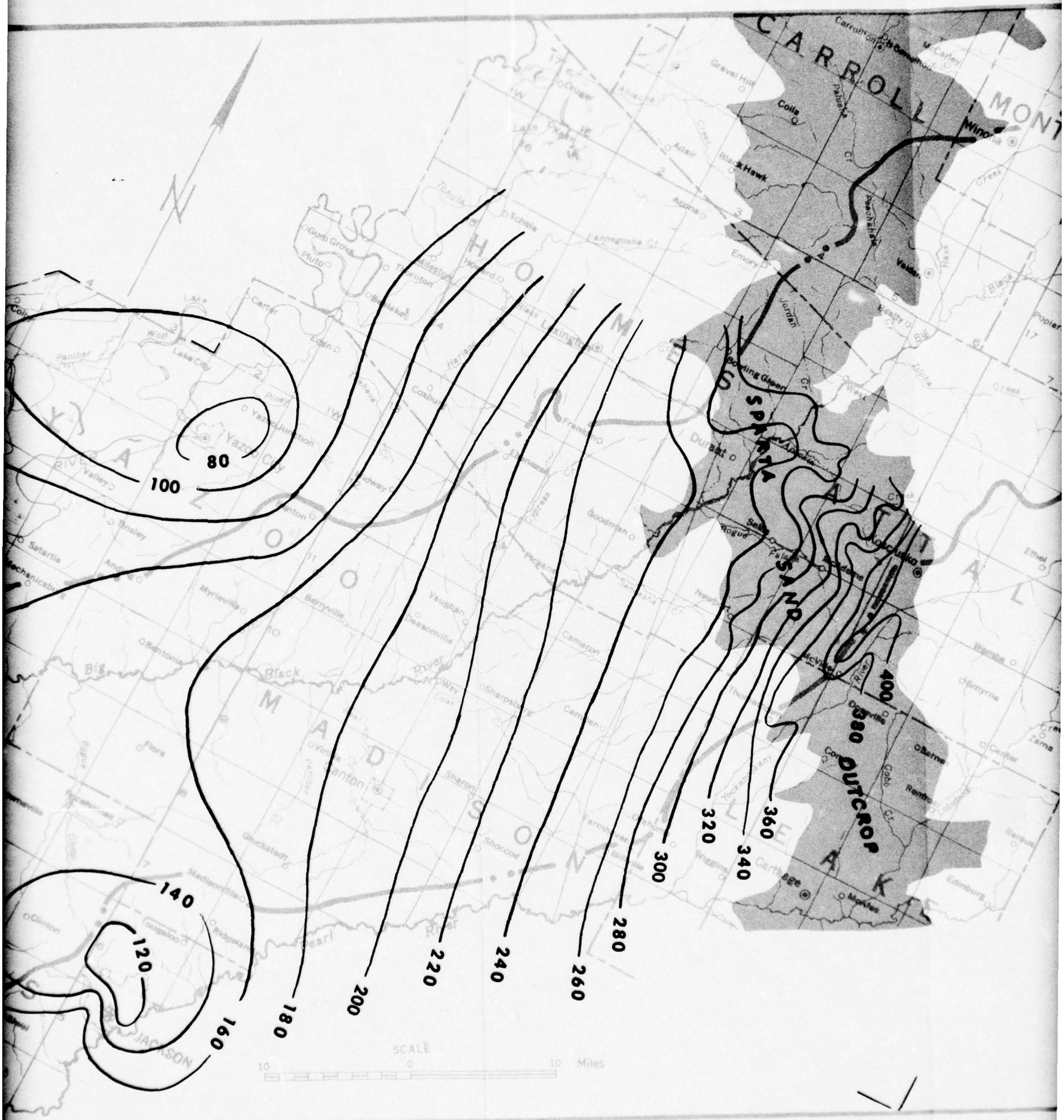
Water-level contour

Shows altitude of water level. Dashed where approximate.

Contour interval 20 feet; datum is mean sea level.

Basin boundary





CARROLL
MONT
SPARTA SAND OUTCROP
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
SCALE
10 0 10 Miles
N
Winona
Carrollton
Lexington
Yazoo City
Canton
Jackson
Kosciusko
Carthage
Durant
Goodman
Pickens
Vaughan
Flora
Clinton
Sharon
Madison
Ridgeland
Cameron
Thomastown
Zama
Bogue
Pearl River
Black River
Big Black

2

Figure 10.--Map showing water levels in the Sparta Sand, 1965, Big Black River basin, Mississippi.

1/

contour map (fig. 10). There is some interference between pumpage at the two localities and increased pumping will cause the depressions to deepen. Water levels in wells in these areas have been declining for many years (fig. 11).

The relatively small pumpage at Canton has not resulted in very noticeable depression in the water-level contours. However, withdrawal of 10 mgd at Canton probably would cause as much depression in the water level as now exists at Jackson, and water levels at each of the three cities would be slightly lower because of pumping at the other two cities.

The part of the Sparta aquifer system that underlies the basin probably would support several well fields producing 10 mgd each before areal water levels would be lowered as much as 200 feet. Well fields producing from the Sparta Sand but located just outside the basin, as at Jackson and Yazoo City, will continue to cause lower water levels in the basin. Water-level elevations will always be higher in and near the aquifer outcrop.

In most places the drawdown caused by pumping can be divided among two or more aquifers by constructing wells in all available aquifers. Naturally, two aquifers will yield more water, or will have less drawdown, than one aquifer.

Quality

Ground water of suitable quality for most uses is available throughout the Big Black River basin. However, quality of water in the artesian aquifers changes with distance down the dip away from the recharge areas (fig. 2). Changes in the quality of ground water underlying the basin are determined mostly by the following factors: (1) the time that water has been in contact

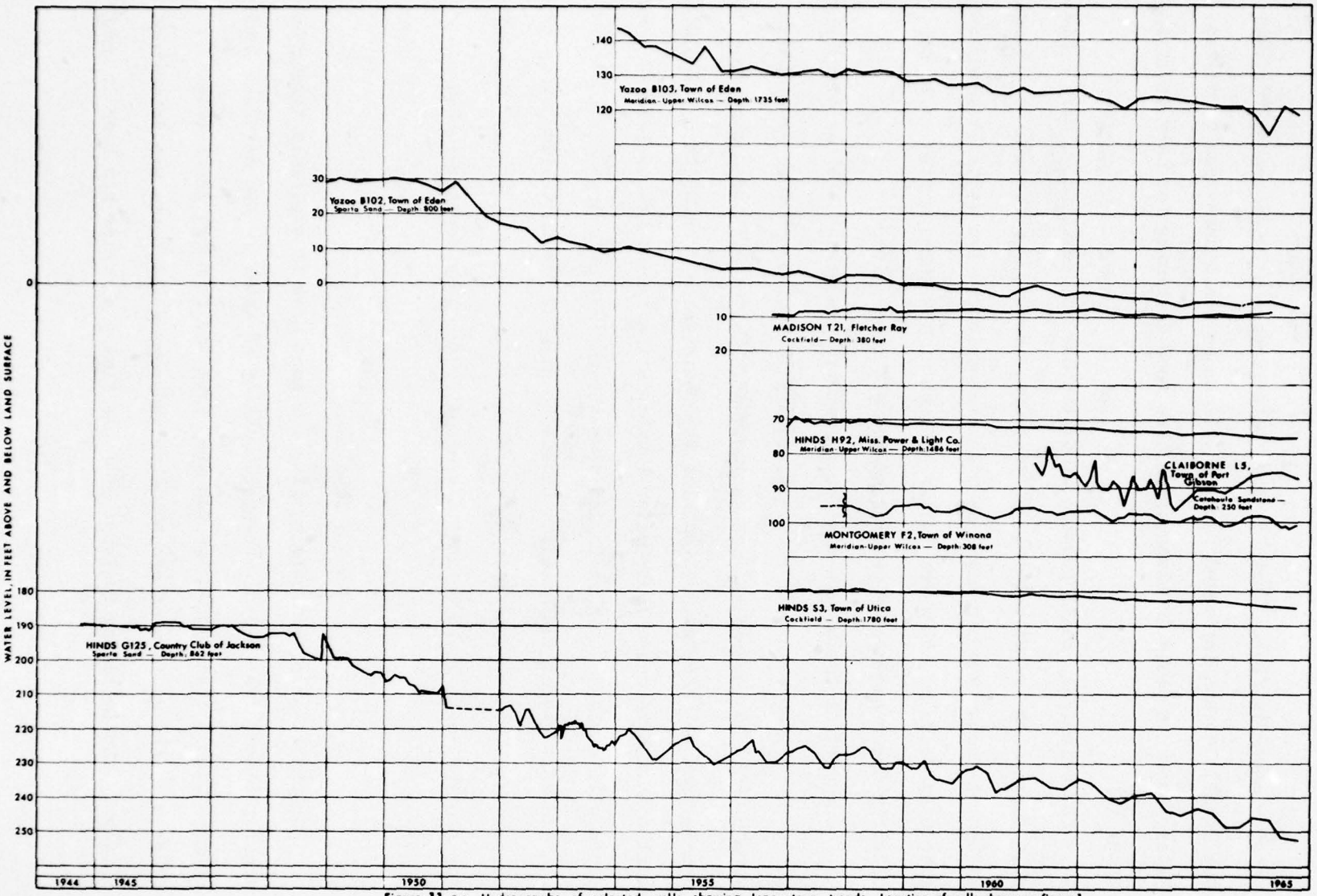


Figure 11. -- Hydrographs of selected wells showing long-term trends. Location of wells shown on figure 1.

with the aquifer material; (2) the chemical composition of the aquifer material; and (3) degree of flushing of saline water by fresh water.

Water levels in all the aquifers indicate that precipitation enters the aquifers in the outcrops and moves slowly in a southwesterly or westerly direction. Vertical movement through beds of clay and silt is extremely slow. The more permeable aquifers contain fresh water farther from the recharge area and deeper below land surface than do less permeable aquifers (fig. 2). Whether this is a result of differences in permeability or other factors has not been established.

Because water is a solvent, it is obvious that the chemical composition of the aquifer material would directly affect the quality of water in the aquifer. However, it is difficult to differentiate between the indirect effect of permeability and that of chemical composition of aquifer material on the quality of water. The marine sands generally are less permeable and contain more of the easily dissolved solids than the non-marine sands. Thus, the usual higher dissolved-solids content of water in marine sands may be attributed to these two causes.

The depth to which fresh water has replaced saline water is a measure of the degree of flushing. Rain water contains practically no dissolved solids, and most shallow water contains less than 100 ppm (parts per million) of dissolved solids (table 2). Water from shallow aquifers in the basin generally is a soft to moderately hard calcium bicarbonate type. The water characteristically has low dissolved-solids content, pH, and color. Calcium, magnesium, iron, and free carbon dioxide are more likely to be present in the shallow parts of the aquifers. Even where iron is not present in

objectionable quantities, an iron problem may develop in a water system because of the naturally corrosive character of water containing substantial carbon dioxide.

Mineralization increases down the dip of the aquifers; color may increase; and the water changes from a calcium bicarbonate type to a sodium bicarbonate type. Most of the dissolved solids, except calcium, magnesium, and iron, increase. Fluoride content is low in the shallow parts of the aquifers, but it increases to objectionable amounts (more than 1 ppm) down the dip in some aquifers. Near the base of fresh water (figs. 2, 12) the type of the water changes from sodium bicarbonate to sodium chloride. Mineralization of water in the deeper parts of the aquifers may be higher than that of sea water.

The artesian aquifers may be several thousand feet below land surface at points many miles down the dip from the outcrops. Several of the aquifer systems contain fresh water (less than 1,000 ppm of dissolved solids) to depths of more than 2,000 feet below sea level, and three of the aquifers have fresh water at almost 3,000 feet below sea level (figs. 2, 12). The slightly saline (1,000-3,000 ppm of dissolved solids) water lying below the fresh water in the aquifers is not used at present, but it may be usable for certain purposes in the future. Practically all water at depths of more than 4,000 feet below land surface is saline; therefore, its utility is limited.

Quality of water is related to the intended use; water of good quality for one use may be unfit for another use. Shallow water in the basin is good for irrigation, but it may need iron removal and pH adjustment for domestic use.

EXPLANATION

-200
Fresh-water contour

Shows altitude of base of fresh-water zone (less than 1,000 ppm dissolved solids). Contour interval 200 feet; datum is mean sea level.

Line showing where the base of fresh water shifts from one aquifer system to another.

The deepest fresh water occurs in the delineated parts of the following aquifer systems:

(1) Catahoula Sandstone

(2) Sparta Sand

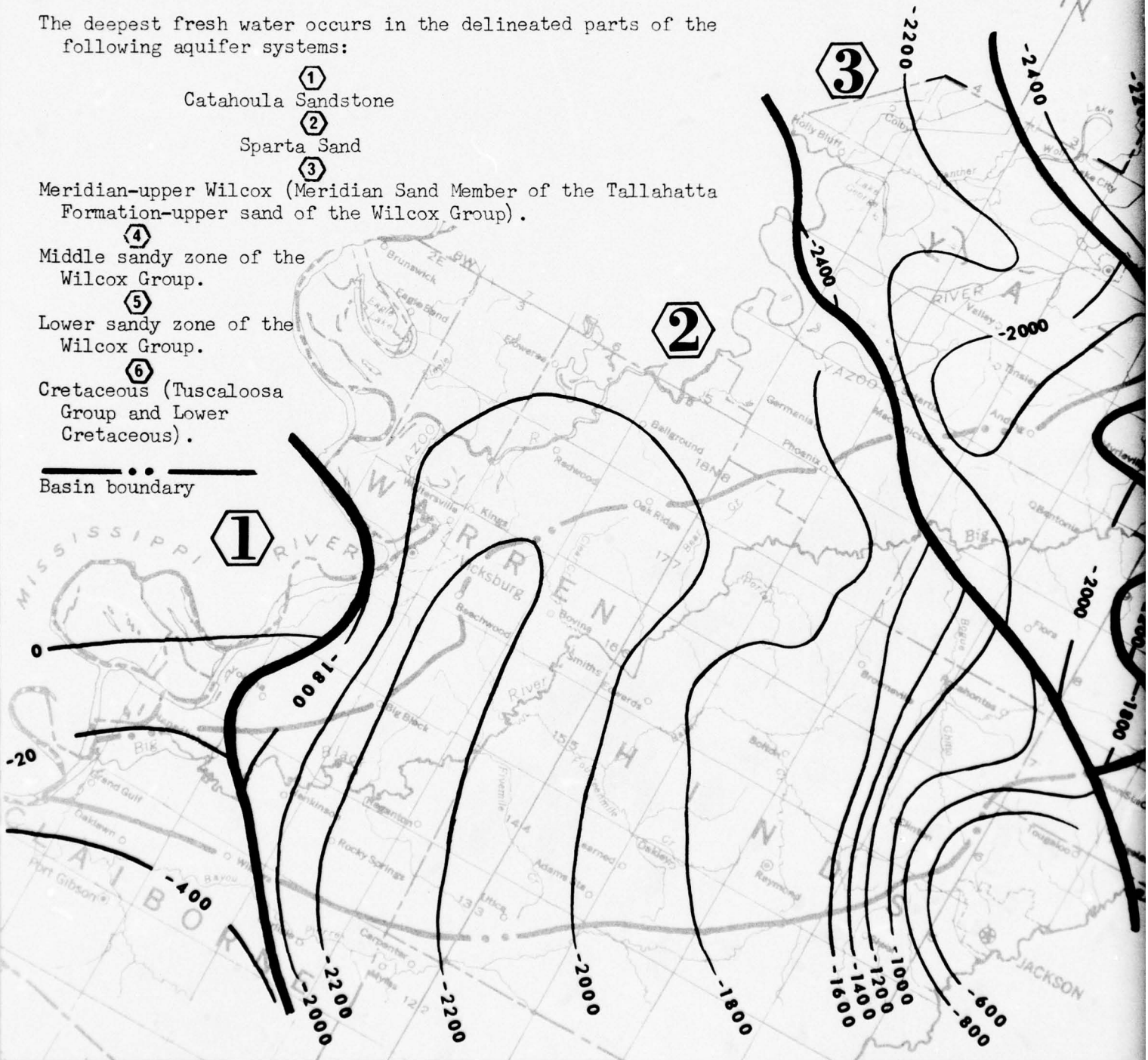
(3) Meridian-upper Wilcox (Meridian Sand Member of the Tallahatta Formation-upper sand of the Wilcox Group).

(4) Middle sandy zone of the Wilcox Group.

(5) Lower sandy zone of the Wilcox Group.

(6) Cretaceous (Tuscaloosa Group and Lower Cretaceous).

Basin boundary



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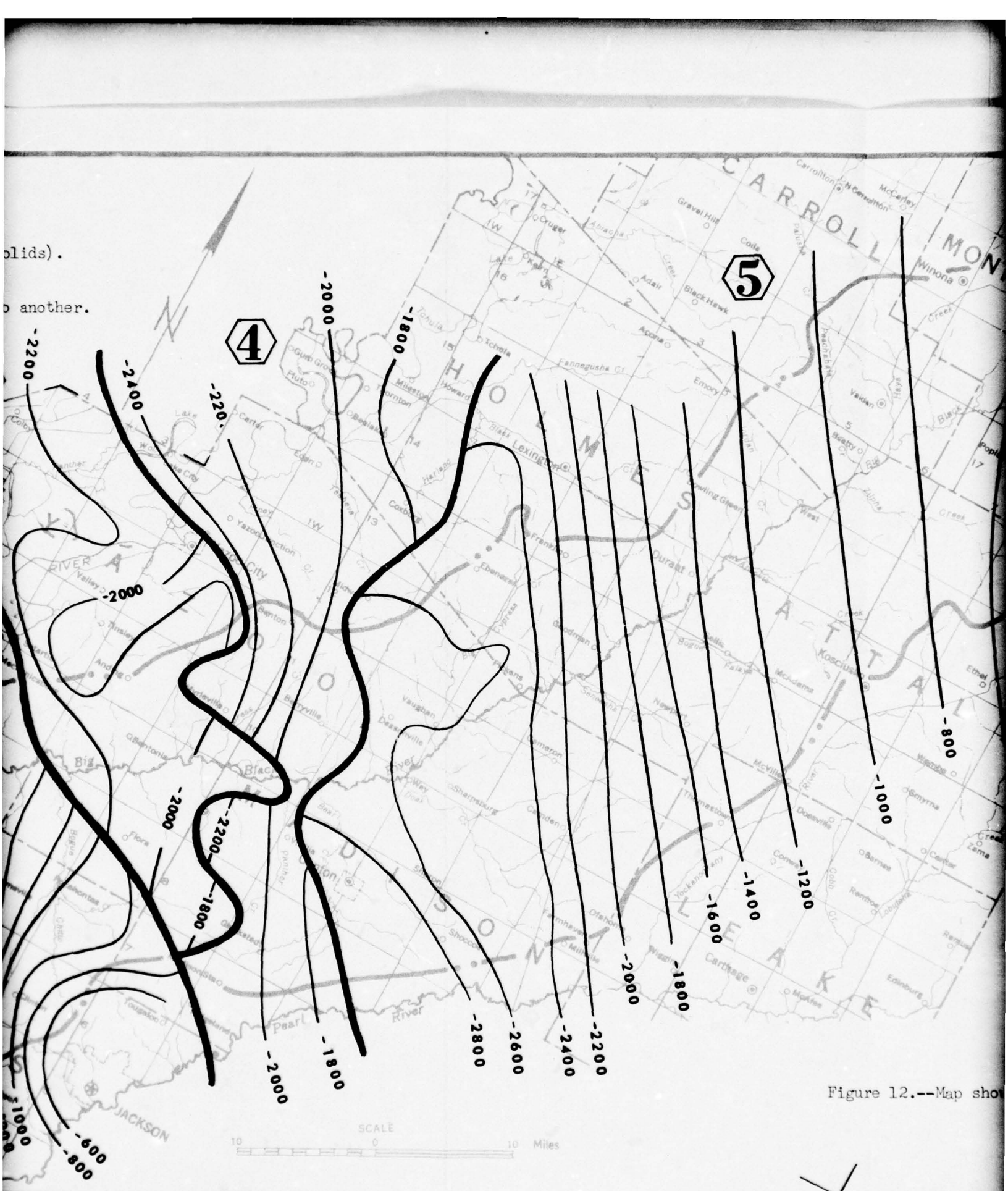

Figure 12.--Map sho

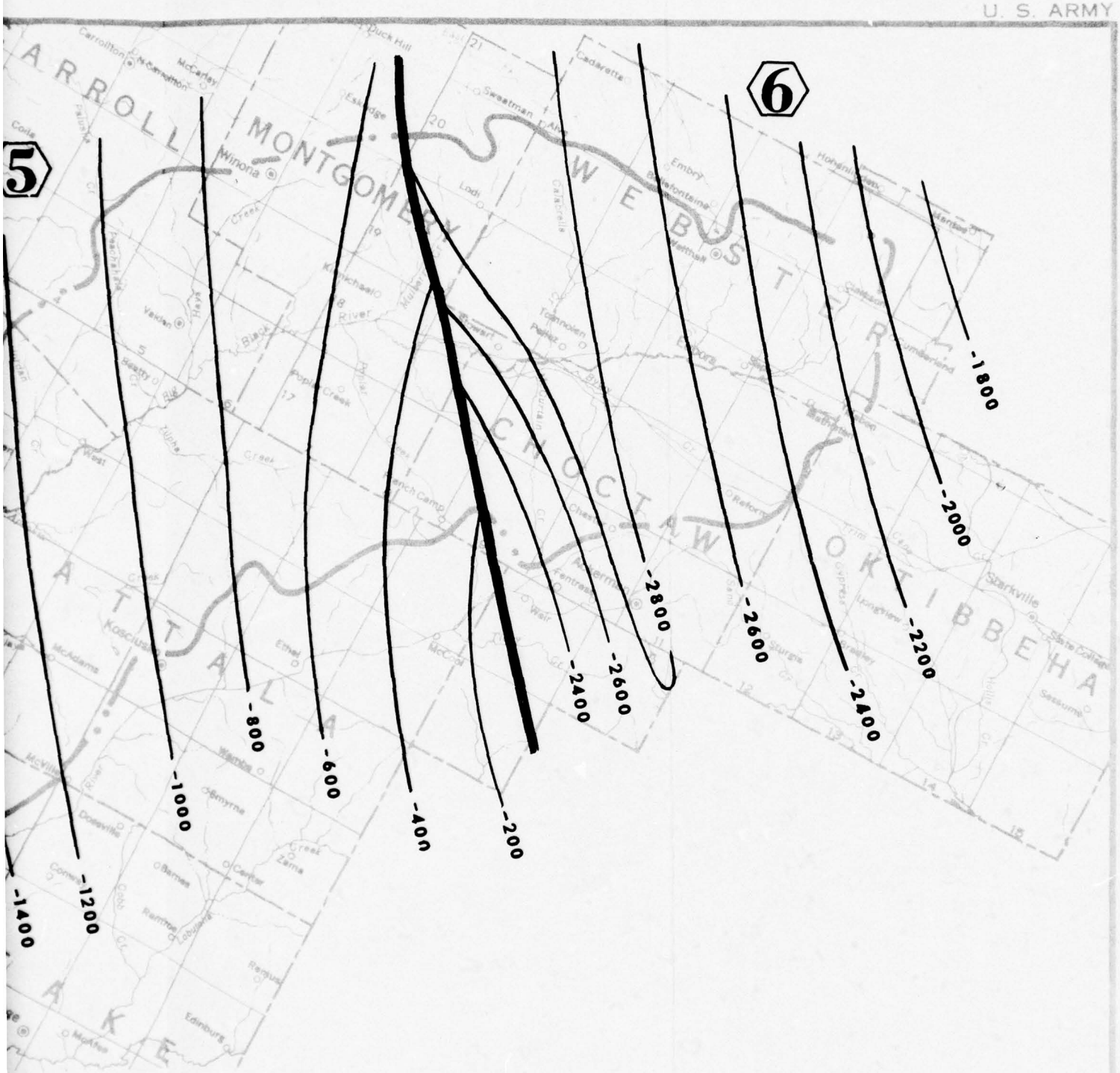

Figure 12.--Map showing base of fresh water in the Big Black River basin, Mississippi.

Deeper water may be suitable for domestic use but, because of a high percentage of sodium, be unfit for irrigation. At most localities two or more aquifers containing water of different quality are available. Table 2 contains analyses of water from various locations (fig. 1) and aquifers.

Temperature of water discharged from certain wells is also shown in table 2. The temperature of shallow ground water is about 65°F, the mean annual air temperature, and the temperature increases about 1°F per 70 feet of additional depth below land surface.

SURFACE WATER

Source and Availability

Most of the streams tributary to the Big Black River in the upper half of the basin are perennial; in the lower half of the basin flow normally stops for some period each year in most tributary streams (fig. 13). This is attributed to the fact that the permeability of the surface and shallow subsurface sediments in the upper half of the basin is greater than in the lower half. All the artesian aquifer systems (fig. 2) are full and overflowing--that is, they receive water in the recharge areas in excess of the amount that will move down dip. The excess is discharged through seeps and springs in the outcrop area to form the base flow of streams. The amount of water discharged from aquifers to streams depends primarily on aquifer permeability, saturated thickness of aquifer, and slope of the water table. Several factors affect the saturated thickness and water-table slope: (1) topography; (2) frequency and amounts of recharge; (3) evapotranspiration; (4) depth of stream channel; and (5) stage of stream.

EXPLANATION

▲ Location of measurements made Sept. 20-21, 1964.

△ Location of measurements made Oct. 19-Nov. 5, 1965

◭ Location of miscellaneous measurements.

$8\frac{182}{430}$ ▲ Number above line is flow in cubic feet per second.

Number below line is specific conductance, in micromhos at 25°C.

Number opposite line is reference number of measuring station.

Geology is after Belt and others (1945).

Basin boundary

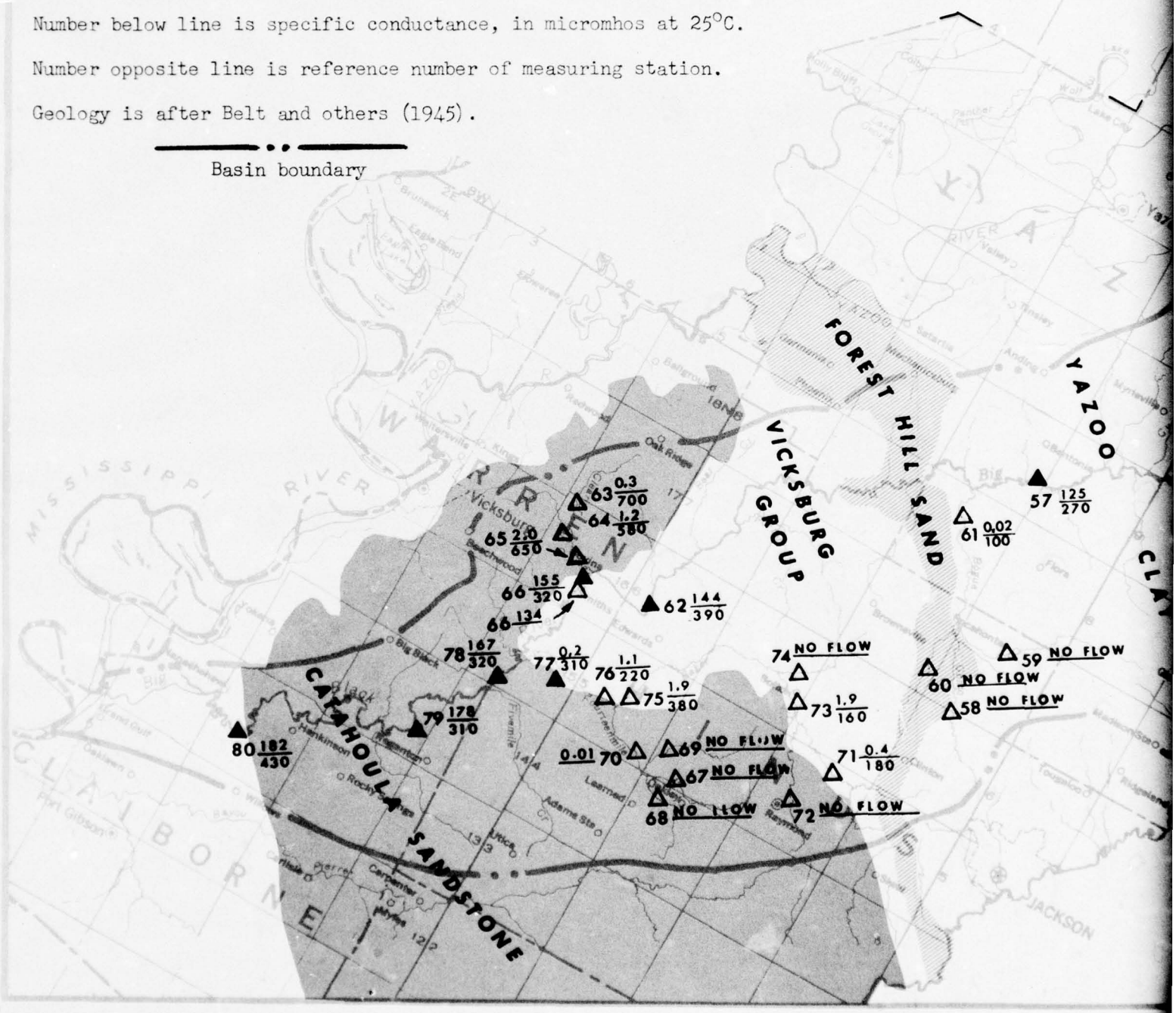

Figure 13.--Geologic map showi
in the Big Black River and
flow data from long-term g
streamflow during the meas
was slightly more than the
content of water at sites
ductance values by 0.65.

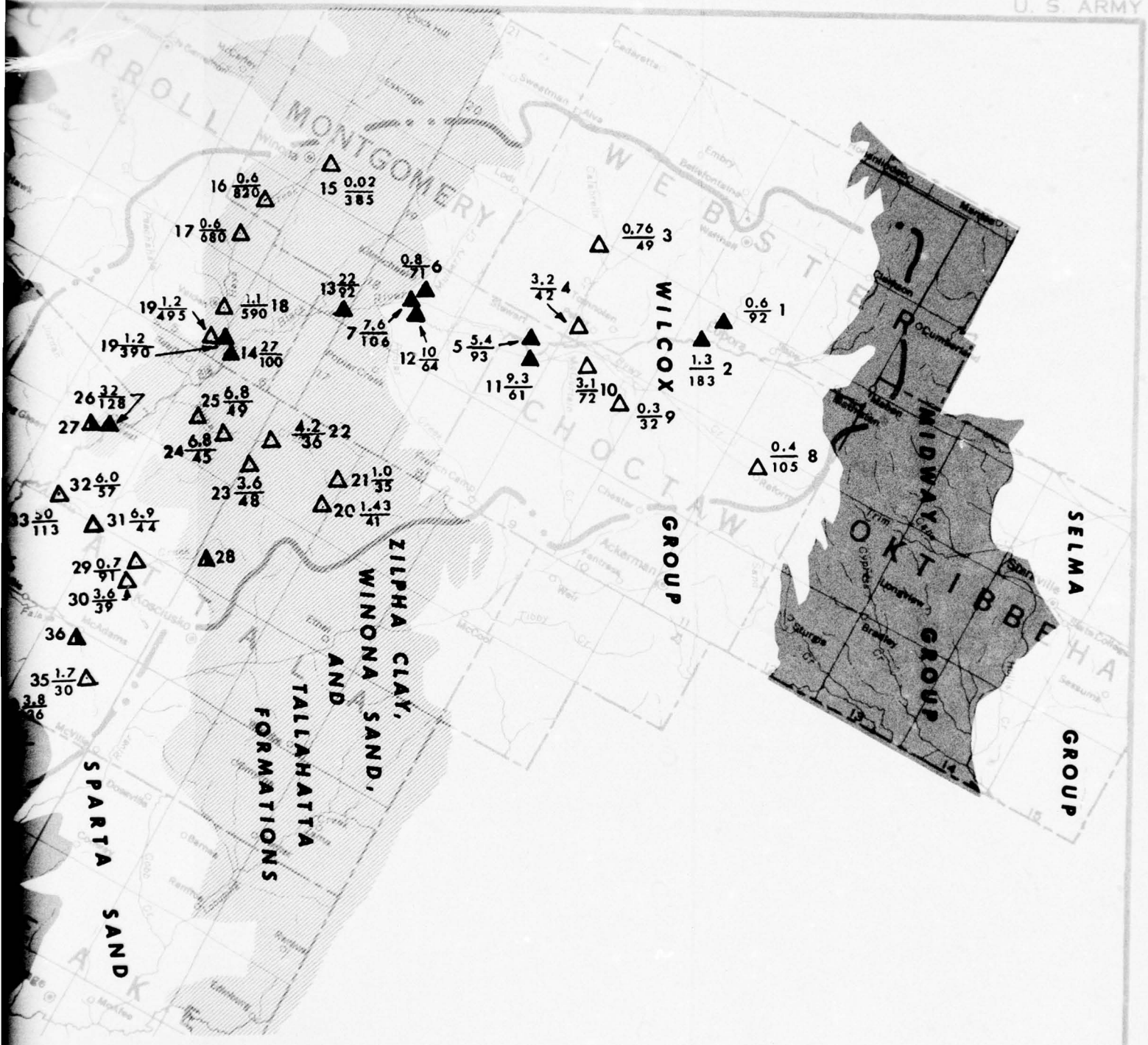

Figure 13.--Geologic map showing low flow and corresponding specific conductance of water in the Big Black River and its tributaries, Big Black River basin, Mississippi. Streamflow data from long-term gaging stations at Pickens, Bentonia, and Bovina indicate that streamflow during the measuring periods (Sept. 20-21, 1964, and Oct. 19-Nov. 5, 1965) was slightly more than the median-annual minimum 7-day average flow. The dissolved-solids content of water at sites on the map may be approximated by multiplying specific conductance values by 0.65.

The shape and slope of the water table are largely determined by topography--that is, the water table tends to conform to the land surface. A sharp drop of about 100 feet in altitude from the Pearl and Yockanookany River basins to that of the Big Black causes a steep water-table gradient and high ground-water discharge to head-water streams of the eastern tributaries of the Big Black. The flood plains of the Yazoo River and its major tributaries are, in turn, about 100 feet lower than the flood plain of the Big Black. The topographic relationships of the western and eastern margins of the Big Black River basin cause the eastern tributaries to be more productive during dry seasons than the western tributaries. The yield of one small eastern basin, about 12 square miles above station 30 (fig. 13) on Apookta Creek, was 0.3 cubic feet of water per second per square mile of drainage basin during a period (October 1965) when flow in the Big Black River was slightly more than for the median annual minimum of 7-day average flow.

Nearly two-thirds of the flow of the Big Black River during dry periods is from the upper half of the basin where perennial tributaries are numerous. Since tributaries in the lower half of the basin do not contribute appreciable quantities of water it could be reasonably assumed that there would be little increase in flow in the lower part of the river. However, about one-third of the total low flow of the Big Black at U.S. Highway 61, which is near the river's mouth, is gained in the lower part of the river. Most of this increased flow in the lower end of the river probably is from the alluvium in the flood plain of the river.

Duration of Flow

Flow-duration data (table 3) indicate that about 90 percent of the time the flow in the Big Black River is as much or more than the values shown on figure 14. Although flow-duration data are not available on the tributaries and upper reaches of the river, it is assumed that 90-percent flow duration in these streams would also be as much or more than the values shown. Storage reservoirs could be constructed to make more surface water available on a continuous basis at almost any place in the basin.

Water Use

Probably less than 500 acre-feet of water is diverted annually from streams in the basin--mostly for supplemental irrigation of row crops. Practically all cattle in the basin are watered from either streams or ponds. The largest use of the streams by towns and industries is for sewage disposal. Water supply and recreational values of the streams increase with each effective sewage treatment facility completed.

Quality

Specific conductance, in micromhos at 25°C, of water in the Big Black River at average or higher flows is less than 70 (table 4) unless there is more than usual pollution from sewage, industrial waste, or oil field brines. (Specific conductance multiplied by 0.65 approximately equals dissolved-solids content in ppm.) Limited data available on the tributaries indicate that water in practically all of them has a specific conductance of less than 60--if not polluted.

During low flow the specific conductance value of water in the lower part of the Big Black, about 320, may be more than twice as much as it is upstream from Pickens, about 120, (fig. 13 and table 4). Hardness is twice as high downstream from Pickens, about 50 ppm, as upstream, about 25 ppm.

The first of two reasons for higher dissolved solids and hardness in the lower part of the Big Black at low flow is that there are more sources of pollution in the lower end. In addition to municipal and industrial waste there is considerable oil-field waste at several places below Pickens. Some of the tributary streams also show pollution from oil fields (fig. 14).

The second reason for increased dissolved solids and hardness below Pickens is geologic. The reach from Pickens to station 78 below Bovina traverses outcrops of the Jackson (Yazoo Clay) and Vicksburg Groups, which are much more calcareous than the geologic units which crop out above Pickens. The calcareous mantle of loess in the lower part of the river could also contribute to the dissolved-solids content and hardness of shallow ground water and, therefore, to that of surface-water base flow. However, the Jackson, Vicksburg, and loess deposits contribute little or no water to tributary streams during dry periods (fig. 13). Since these geologic units do not contribute appreciable base flow to streams they cannot directly affect the quality of base-flow water in the Big Black. However, the quality of water in the alluvium in the Big Black River valley probably is affected by the Jackson, Vicksburg, and loess sediments. Water in the alluvium is hard to very hard (150-350 ppm) and moderately mineralized (200-500 ppm dissolved solids). During very dry periods nearly half of the flow in the lower end of the river may be alluvial water.

Except for water in the alluvium, there is generally no great difference in the quality of shallow water in the various aquifers--as is demonstrated by relating quality of water in streams at low flow (discharged ground water) to the geologic units traversed by the streams (fig. 13). However, stream station 29 and 30 in Attala County show a significant contrast in water quality. Dissolved-solids content of water in the Winona Sand is higher than that of the Sparta Sand. Most of the water passing station 29 at low flow is from the Winona Sand, and most of the water passing station 30 is from the Sparta Sand. The specific conductance readings of 91 at station 29 and 39 at station 30 seem to accurately reflect the quality of water in the two aquifers.

RELATIVE SIGNIFICANCE OF WATER SOURCES

Using quantity as a standard for judging sources of water, the normal-annual-low-flow of the Big Black River is the most important source of water in the part of the basin downstream from Bentonia (fig. 13). From Bentonia up to Durant possibly as much ground water can be developed from large well fields as is available in the Big Black River during a normal-annual-low-flow period. Upstream from Durant and along the tributary streams, more water is generally available from ground water than from the streams during periods of low flow. Storage reservoirs could be constructed on many of the tributary streams that would yield more water than would be locally available from ground water.

The aquifers underlying the area are unequal in their ability to yield water. A geohydrologic section (fig. 2) classifies the aquifers with respect to their ability to yield water to wells, and eight of the aquifer systems in

the basin are rated good or better (will yield 6 gpm or more per foot of drawdown to properly constructed wells).

Of what value is a particular aquifer system to the people and economy of the Big Black River basin? Quantity is not the only basis for judging the usefulness or importance of aquifers--other bases are quality, availability, pumping lift, treatment, and cost per unit volume. Figures 2 and 12 summarize and compare the quality of water in the various aquifers. Water levels in the aquifers were compared earlier in the report and availability of the aquifers can be compared by using figures 2 through 6. An attempt is hereby made to evaluate and to rank the overall importance of the various aquifer systems to the people and to the economy of the basin. The aquifer systems are grouped and listed in order of importance, the most important being first, as follows:

1. Sparta Sand

   Meridian-upper Wilcox

   Lower sandy zone of the Wilcox Group

2. Cockfield Formation

   Gordo Formation

   Middle sandy zone of the Wilcox Group

   Catahoula Sandstone

3. Winona-Tallahatta

   Coker Formation

   Forest Hill Sand

   Alluvium

4. Eutaw Formation

   McShan Formation

CONCLUSIONS

Large quantities of water are available from several of the geologic units underlying the basin; at most places water of good quality may be developed from two or more major aquifers, each of which will yield to a well more than 1,000 gpm with reasonable drawdown. Well fields in each major aquifer may produce more than 10 mgd. Water-level declines and pumping lifts can be minimized by pumping from all the aquifers available. Dissolved solids, pH, and percentage of sodium increase with depth; iron and hardness are more likely to be problems in shallow water; the base of fresh water averages about 2,000 feet below land surface. Most water supplies in the basin are from ground water.

Perennial streams are numerous in the upper part of the basin, and about 95 percent of the time flow exceeds 100 cfs in the lower half of the river's main stem. Quality of surface water is excellent, except for minor organic pollution from municipal waste and brine pollution from several oil fields in the lower part of the basin. Presently, streams are used chiefly for recreation and waste disposal.

Base flow of the streams, which is ground-water overflow or discharge, will not be significantly affected by heavy pumping from the artesian aquifers. Heavy pumping for consumptive uses in the outcrops of the aquifers could significantly reduce the base flow of some streams, but consumptive use is not likely, except for irrigation.

Much more needs to be known about the geohydraulics of the aquifers in order to make accurate predictions of the effects of developments in them. Detailed ground-water investigations should precede large ground-water developments.

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Table 1.--Aquifer characteristics determined from pumping tests in and near the Big Black River basin

County	Location of test	Water-bearing unit	Aquifer thickness (ft)	Pumped well					Aquifer characteristics			
				Well No.	Diameter (in)	Depth (ft)	Yield (gpm)	Specific capacity (gpm/ft of drawdown at 24 hrs.)	Coefficient of transmissibility (gpd/ft)	Coefficient of permeability (gpd/ft^2)	Coefficient of storage	Theoretical specific capacity of 12-inch well (gpm/ft of drawdown at 24 hrs.)
Attala	Kosciusko	Meridian-upper Wilcox	74	M44	18,12	422	1,000	29	55,000	740	0.0002	25
Do	Kosciusko, 8 miles S.	Meridian	--	S19	6	460	16	.8	9,000	--	--	4
Carroll	Vaiden	Neshoba	83	02	12,8	196	172	2.6	4,800	58	.0005	2
Claiborne	Port Gibson	Catahoula	27	L3	12,?	153	240	--	15,000	550	.0002	7
Hinds	Jackson (west)	Sparta	80	G3	4	802	--	--	42,000	520	.0002	20
Do	Jackson (north)	do	130	H55	10,6	796	400	19	80,000	600	--	36
Do	do	do	73	H104	8,6	810	150	8	34,000	460	.00003	15
Do	Raymond	Cockfield	125	L5	12,8	1,185	239	4	35,000	280	.0001	16
Do	Waterways Experiment Station	do	55	M30	10	637	150	--	10,000	180	.00007	4
Do	Utica	Catahoula	53	S2	10,8	307	180	14	37,000	700	.0024	19
Holmes	Lexington	Meridian	100	L46	8	1,125	227	--	62,000	620	.00009	24
Do	Durant	do	130	T4	10,6	700	440	--	45,000	350	.006	24
Montgomery	Winona	Meridian-upper Wilcox	60	F3	16,10	306	550	24	56,000	910	.0002	25
Do	Stewart	Wilcox	36	L2	6,4	580	47	.4	1,530	42	--	1
Oktibbeha	Maben	Gordo	55	A7	8	1,951	300	--	85,000	1,550	--	40

Table 2.--Chemical analyses of water from wells in the Big Black River basin

(Constituents are in parts per million)

Well No. on map	Owner	Depth (ft)	Yield (gpm)	Water-bearing unit	Date of collection	Dissolved solids	pH	Silica (SiO_2)	Total iron (Fe)	Hardness as $CaCO_3$	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Temperature (°F)	Analyst[a]
Recommended limits, U.S. Public Health Service drinking-water standards (1962)						500			0.3				250	250	1.0	45		
ATTALA COUNTY																		
C3	D. E. Wasson	402	10	Wilcox	10- 1-61	148	6.5	35	0.03	59	6.4	81	12	0.0	0.1	0.3	66	USGS
E1	Moore No. 1 oil test	400?	100	Meridian-Wilcox	1- 3-62	156	7.4	37	.82	68	6.9	92	11	2.0	.1	.0	67	Do
G3	E. E. Gentry	6	1	Winona	2-13-57	32	7.1	--	.48	17	5.6	15	1	12	.2	.5	--	Do
G18	Woodrow Kelly	560	10	Wilcox	11- 7-63	135	7.3	29	2.4	73	11	108	7.2	2.8	.1	.4	--	Do
K12	Ed Gordon	126	10	Sparta	2-28-57	96	--	--	--	40	21	88	7	6.5	.2	.7	--	Do
K30	Norris Culpepper	130	--	do	8-21-62	--	6.2	--	--	55	--	--	--	8.0	--	--	--	Do
L6	W. H. McCrory	168	4	Tallahatta	2- 1-57	225	7.2	--	--	174	14	198	23	12	.1	2.7	--	Do
L21	H. E. Jenkins	212	--	do	10- 4-62	--	7.0	--	--	105	--	--	--	4.8	--	--	--	Do
M44	City of Kosciusko	422	1,000	Meridian-Wilcox	9- 5-62	134	6.5	41	.17	52	2.5	60	13	3.1	.0	.1	67	Do
S19	Natchez Trace (Holly Hill)	460	16	do	11- 7-63	187	7.2	40	2.0	97	14	126	21	3.0	.1	4.7	68	Do
CARROLL COUNTY																		
O1	Town of Vaiden	210	110	Tallahatta	1- 4-57	197	6.0	--	2.5	101	7.4	90	47	3.8	0.0	1.9	65	USGS
O2	do	196	180	do	11-15-62	136	6.1	9.2	1.0	96	--	64	41	6	.1	--	65	MSBH
CHOCTAW COUNTY																		
B2	Town of Mathiston	44	75	Wilcox	1-18-57	104	6.2	--	0.00	23	16	26	18	14	0.0	0.6	62.5	USGS
D1	Natchez Trace (Little Mountain)	350	--	do	8- 1-58	193	7.9	--	--	39	--	171	--	12	--	.0	--	MSCL
F1	French Camp Academy	670	--	do	1-14-57	186	8.3	--	2.9	24	52	158	3.4	4.5	.0	.2	--	USGS
H1	Town of Ackerman	100	400	do	1-16-57	66	5.5	9.3	.21	15	6.0	9	1.3	10	.1	6.3	64	Do
J1	Town of Weir	117	51	do	1-16-57	66	6.0	--	.02	19	5.7	16	.6	12	.0	1.4	64	Do
J6	do	105	150	do	7-29-65	67	5.2	1.2	0	32	b 13	12	0	35	0	--	65	MSBH
CLAIBORNE COUNTY																		
F3	Port Gibson Oil Works	200	--	Catahoula	11- 3-61	412	8.0	49	--	15	136	315	3.0	17	0.3	0.0	68	USGS
L3	Town of Port Gibson	200	411	do	3-22-61	354	7.4	56	0.16	52	101	322	.6	3.3	.2	.1	68	Do
L12	do	1,740	--	Cockfield	1909	22,640	--	99	--	--	--	--	--	--	--	--	--	MSCL
N1	Claiborne County Lumber Co.	100	40	Catahoula	10-20-61	167	6.9	41	.18	55	17	52	21	20	.1	.0	--	USGS
N5	Hugh Rials	200	6	do	10-18-61	483	7.4	33	.32	8	177	451	.4	23	.3	.0	--	Do
HINDS COUNTY																		
A4	Bill McGraw	204	5	Forest Hill	9- 9-59	791	8.3	--	0.11	38	262	452	214	12	0.5	4.8	82	USGS
C11	G. B. DeWees	890	40	Cockfield	10-26-56	359	8.3	--	.26	4	146	271	50	30	.2	1.1	71	Do
C12	Texas Eastern Gas Transmission Co.	1,111	--	Sparta	1-29-58	263	8.6	12	.10	2	73	254	3.2	3.2	.0	.3	--	Do
D1	Town of Edwards	1,154	300	Cockfield	10-22-56	394	7.7	--	.35	9	122	241	62	16	.1	.4	87	Do
D8	- - Campbell	55	--	Alluvium	4-15-59	308	8.5	15	.04	224	16	244	22	10	.3	15	65	Do
D9	J. C. Logan	1,000	9	Cockfield	7- 1-58	614	8.2	9.5	.18	20	221	576	.3	24	2.8	3.0	69	Do
E3	Town of Bolton	1,027	300	do	10-22-56	382	8.6	--	.12	3	142	272	40	26	--	.7	84	Do
F5	W. W. Newman	170	--	Forest Hill	9- 9-59	342	8.1	9.3	.11	22	111	298	21	3.5	.3	2.1	71	Do
G36	Town of Clinton	726	293	Cockfield	10-22-56	393	8.6	--	1.7	76	118	239	86	27	.1	2.1	76	Do
H92	Mississippi Power & Light Co.	1,486	5	Meridian-Wilcox	10- 2-56	1,210	8.5	9.2	.85	6	485	1,170	1.2	14	6.0	2.4	64	Do
J1	H. H. Canada	308	28	Forest Hill	9- 9-59	775	8.7	6.7	.37	8	289	656	.0	32	2.4	2.0	70	Do
L5	Town of Raymond	1,185	251	Cockfield	10-22-56	398	8.5	--	.15	3	141	281	33	26	--	1.3	92	Do
L19	Hinds Junior College	874	--	do	2- 3-58	416	8.6	12	.54	3	143	297	32	25	--	1.6	75	Do
N35	Heidelberg Hotel	712	300	Sparta	1-30-57	330	8.8	12	.04	4	120	300	3.6	7.0	.4	.9	-	Do
R2	Jackson Reduction Co.	1,275	350	do	1-30-58	380	8.2	11	.30	2	144	338	19	16	--	1.6	--	Do
S2	Town of Utica	307	180	Catahoula	1-30-58	359	7.2	41	.69	7	149	238	63	16	.3	.1	68	Do
S3	do	1,310	150	Cockfield	6-30-44	1,310	8.3	13	.04	9	529	1,240	2.9	50	4.4	.0	88	Do
T7	Daisy Cochran	401	--	Forest Hill	9- 9-59	608	8.4	6.1	.04	9	220	542	15	9.0	2.0	2.9	73	Do
U16	D. Holliday	553	20	do	9- 9-59	741	8.4	7.7	.14	4	279	692	3.3	12	4.0	4.3	78	Do
HOLMES COUNTY																		
F1	Town of West	412	55	Meridian-Wilcox	1- 4-57	148	7.4	--	1.9	57	17	104	6.6	2.5	0.0	1.5	67	USGS
F2	do (at tank)	385	150	do	9-26-60	121	6.5	14	4.4	69	b 12	87	10.54	4	0	--	-	MSBH
L45	Town of Lexington	900	150	Tallahatta	11- 3-58	416	7.8	43	0	0	b 162	352	0	0	0	--	--	Do
L46	do	1,125	320	Meridian-Wilcox	3-13-40	184	8.3	17	.16	6.5	64	160	13	2.2	--	.0	--	USGS
T4	Town of Durant (water plant)	700	500	do	11-12-63	159	7.4	30	.78	56	28	130	12	3.0	.1	.1	70	Do
T17	do	701	560	do	1- 3-62	123	7.4	.4	.5	--	b 30	101	11	3	.1	--	--	MSBH
W2	Town of Pickens (water plant)	1,580	200	Wilcox	1- 3-57	242	8.7	--	.09	4	86	206	9.6	2.2	.4	.6	82	USGS
W4	do	1,585	620	do	7-24-63	238	7.4	15	.13	3	83	207	9.4	1.2	.2	.1	87	Do
X1	Town of Goodman (old well)	1,080	120	Meridian-Wilcox	7-12-60	176	8.3	4.4	.2	2	b 81	131	13	6	0	--	--	MSBH
X2	do	[illegible]	[illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

B2	Town of Mathiston	44	75	Wilcox	1-18-57	104	6.2	--	0.00	23	16	26	18	14	0.0	0.6	62.5	USGS
D1	Natchez Trace (Little Mountain)	350	--	do	8- 1-58	193	7.9	--	--	39	--	171	--	12	--	.0	--	MSCL
F1	French Camp Academy	670	--	do	1-14-57	186	8.3	--	2.9	24	52	158	3.4	4.5	.0	.2	--	USGS
H1	Town of Ackerman	300	400	do	1-16-57	66	5.5	9.3	.21	15	6.0	9	1.3	10	.1	6.3	64	Do
J1	Town of Weir	117	51	do	1-16-57	66	6.0	--	.02	19	[b] 5.7	16	.6	12	.0	1.4	64	Do
J6	do	105	150	do	7-29-65	67	5.2	1.2	0	32	[b] 13	12	0	35	0	--	65	MSBH
									CLAIBORNE COUNTY									
F3	Port Gibson Oil Works	200	--	Catahoula	11- 3-61	412	8.0	49	--	15	136	315	3.0	17	0.3	0.0	68	USGS
L3	Town of Port Gibson	200	411	do	3-22-61	354	7.4	56	0.16	52	101	322	.6	8.3	.2	.1	68	Do
L12	do	1,740	--	Cockfield	1909	22,640	--	99	--	--	--	--	--	--	--	--	--	MSCL
N1	Claiborne County Lumber Co.	100	40	Catahoula	10-20-61	167	6.9	41	.18	55	17	52	21	20	.1	.0	--	USGS
N5	Hugh Rials	200	6	do	10-18-61	483	7.4	33	.32	8	177	451	.4	23	.3	.0	--	Do
									HINDS COUNTY									
A4	Bill McGraw	204	5	Forest Hill	9- 9-59	791	8.3	--	0.11	38	262	452	214	12	0.5	4.8	82	USGS
C11	G. B. DeWees	890	40	Cockfield	10-26-56	359	8.3	--	.26	4	146	271	50	30	.2	1.1	71	Do
C12	Texas Eastern Gas Transmission Co.	1,111	--	Sparta	1-29-58	263	8.6	12	.10	2	78	254	3.2	3.2	.0	.3	--	Do
D1	Town of Edwards	1,154	300	Cockfield	10-22-56	394	7.7	--	.35	9	122	241	62	16	.1	.4	87	Do
D8	- - Campbell	55	--	Alluvium	4-15-59	308	8.5	15	.04	224	16	244	22	10	.3	15	65	Do
D9	J. C. Logan	1,000	9	Cockfield	7- 1-58	614	8.2	9.5	.13	20	221	576	.8	24	2.8	3.0	69	Do
E3	Town of Bolton	1,027	300	do	10-22-56	382	8.6	--	.12	3	142	272	40	26	--	.7	84	Do
F5	W. W. Newman	170	--	Forest Hill	9- 9-59	342	8.1	9.3	.11	22	111	298	21	3.6	.3	2.1	71	Do
G36	Town of Clinton	726	293	Cockfield	10-22-56	393	8.6	--	1.7	76	118	239	86	27	.1	2.1	76	Do
H92	Mississippi Power & Light Co.	1,436	5	Meridian-Wilcox	10- 2-56	1,210	8.5	9.2	.35	6	435	1,170	1.2	14	6.0	2.4	84	Do
J1	H. H. Canada	308	28	Forest Hill	9- 9-59	775	8.7	6.7	.37	8	239	656	.0	32	2.4	2.0	70	Do
L5	Town of Raymond	1,185	251	Cockfield	10-22-56	398	8.5	--	.15	3	141	281	33	26	--	1.3	92	Do
L19	Hinds Junior College	874	--	do	2- 3-58	416	8.6	12	.54	3	143	297	32	25	--	1.6	75	Do
N35	Heidelberg Hotel	712	300	Sparta	1-30-57	330	8.3	12	.04	4	120	300	3.6	7.0	.4	.9	-	Do
R2	Jackson Reduction Co.	1,275	350	do	1-30-58	380	8.2	11	.30	2	144	338	19	16	--	1.6	--	Do
S2	Town of Utica	307	180	Catahoula	1-30-58	359	7.2	41	.69	7	149	238	63	16	.3	.1	68	Do
S3	do	1,310	150	Cockfield	6-30-44	1,310	8.3	13	.04	9	529	1,240	2.9	50	4.4	.0	38	Do
T7	Daisy Cochran	401	--	Forest Hill	9- 9-59	608	8.4	6.1	.04	9	220	542	15	9.0	2.0	2.9	72	Do
U16	D. Holliday	553	20	do	9- 9-59	741	8.4	7.7	.14	4	279	692	3.8	12	4.0	4.3	78	Do
									HOLMES COUNTY									
F1	Town of West	412	55	Meridian-Wilcox	1- 4-57	148	7.4	--	1.9	57	17	104	6.6	2.5	0.0	1.5	67	USGS
F2	do (at tank)	385	150	do	9-26-60	121	6.5	14	4.4	69	[b] 12	37	10.54	4	0	--	--	MSBH
L45	Town of Lexington	900	150	Tallahatta	11- 3-58	416	7.3	43	0	0	[b] 162	352	0	0	0	--	--	Do
L46	do	1,125	320	Meridian-Wilcox	3-13-40	184	8.3	17	.16	6.5	64	160	13	2.2	--	.0	--	USGS
T4	Town of Durant (water plant)	700	500	do	11-12-63	159	7.4	30	.78	56	28	130	12	3.0	.1	.1	70	Do
T17	do	701	560	do	1- 3-62	123	7.4	.4	.5	--	[b] 30	101	11	3	.1	--	--	MSBH
W2	Town of Pickens (water plant)	1,580	200	Wilcox	1- 3-57	242	8.7	--	.09	4	86	206	9.6	2.2	.4	.4	82	USGS
W4	do	1,585	620	do	7-24-63	238	7.4	15	.13	3	83	207	9.4	1.2	.2	.1	87	Do
X1	Town of Goodman (old well)	1,080	120	Meridian-Wilcox	7-12-60	176	8.3	4.4	.2	2	[b] 81	131	13	6	0	--	-	MSBH
X2	do	980	596	do	11-12-63	165	7.8	14	.03	1	69	167	12	2.3	.1	1.0	70	USGS
X21	Town of Goodman	735	100	Tallahatta	8-22-19	372	--	50	.09	16	--	322	14	3.5	--	--	--	MSCL
									MADISON COUNTY									
D17	Madison County Schools	730	75	Sparta	1-31-58	213	7.1	38	3.1	14	47	133	5.8	4.8	0.2	0.3	50	USGS
K1	Kearney Park Utility Co.	1,332	430	do	11-20-42	220	8.1	45	1.2	28	63	152	3.8	2.4	--	0	--	Do
K2	do	1,404	750	do	11-20-42	220	8.0	48	1.2	30	61	151	7.0	2.4	--	.1	--	Do
K5	Madison Development Co.	1,398	455	do	11-20-42	227	8.0	62	--	19	64	143	10	2.3	--	0	--	Do
L4	Tom Taylor	1,533	--	Wilcox	7- 3-57	494	8.5	6.8	1.5	3	188	450	1.2	5.0	.1	1.7	80	Do
M7	City of Canton	980	500	Sparta	10-26-56	166	8.1	--	2.4	20	37	99	.6	4.5	.1	.6	77	Do
M8	do	965	750	do	10-12-60	118.37	6.4	1.6	1.0	18.6	[b] 40.04	--	13.33	6	0	--	--	MSBH
M9	do	975	1,100	do	10-12-60	115.06	6.4	0	.75	18.4	[b] 38.64	--	12.76	6	0	--	--	Do
R1	Town of Flora	1,366	510	do	10-26-56	218	8.6	--	.20	4	88	212	5.8	2.5	.3	.7	86	USGS
R2	do	1,304	84	do	10-26-56	713	8.4	--	.96	23	250	252	170	130	.3	1.3	75	Do
T20	H. E. Lee	462	12	Cockfield	10-26-56	209	8.4	--	.99	65	47	153	30	7.5	.1	.7	69	Do
V14	Theo Costas	898	105	Sparta	5- 4-56	744	8.2	--	.71	54	249	190	210	158	.3	2.3	82	Do
W2	Town of Madison	650	80	Cockfield	6-13-58	387	7.5	--	0	15	120	248	53	20	.0	2.2	73	Do
W3	Town of Ridgeland	703	150	do	6-13-58	414	7.9	--	.04	6	142	268	51	32	.1	.2	79	Do
									MONTGOMERY COUNTY									
A17	Town of Duck Hill	650	90	Wilcox	4-29-60	360	8.6	4.0	0.1	7.3	[b] 148	266	0	44	0	--	--	MSHH
F3	City of Winona	314	525	Meridian-Wilcox	1-14-57	108	6.8	24	2.3	39	4.4	42	12	4.0	.1	0.3	64	USGS
F4	City of Winona	306	--	do	4-29-60	66.35	5.7	10.8	4.0	33	[b] 5.38	33	10.37	5	0	--	--	MSBH
F22	C. H. George	445	50	do	1- 3-62	146	7.4	32	9.4	56	7.6	73	13	2.9	.1	0	--	USGS
J1	Mississippi State Forestry	360	600	do	1- 3-62	161	7.5	37	1.8	70	6.9	78	21	3	.2	0	65	Do
K2	Town of Kilmichael	169	--	do	11- 5-59	99.43	5.2	12.4	4.5	39.4	[b] 2	11	36.71	15	.1	--	--	MSBH
K3	do	150	75	do	1-18-57	138	6.7	--	.01	41	12	10	39	15	0	.3	64	USGS
K4	Kilmichael Colored School	588	--	Wilcox	1- 3-62	238	8.1	9.5	.02	9	85	235	1.4	2.6	.2	0	--	Do
K5	Town of Kilmichael	480	200	do	5-22-63	191.41	8.6	6.2	.1	14	[b] 74.06	161	0	7	.2	--	--	MSBH

Table 2.--Continued

Well No. on map	Owner	Depth (ft)	Yield (gpm)	Water-bearing unit	Date of collection	Dissolved solids	pH	Silica (SiO_2)	Total iron (Fe)	Hardness as $CaCO_3$	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Temperature (°F)	Analyst[a]
							OKTIBBEHA COUNTY											
A1	Town of Maben	2,032	100	Gordo	10-27-54	574	7.6	9.7	0.17	49	3.5	29	1.4	2.5	0.2	0	64	USGS
A7	do	1,950	225	do	10-26-62	537.77	7.8	2.8	.1	43.2	[b]197.57	120	0	250	--	--	89	MSBH
							WARREN COUNTY											
C1	B. N. Simrall	1,076	--	Cockfield	3-16-62	490	8.5	11	0.33	5	135	305	82	36	0.3	0.2	72	USGS
C6	do	1,621	140	Sparta	3-16-62	325	8.4	13	.15	2	130	324	.2	2.6	.2	.3	80	Do
F8	Hugh Morris	110	--	Forest Hill	3-16-62	332	8.2	17	.03	150	47	306	.2	5.1	.1	.1	--	Do
J1	Vicksburg Industrial Park	1,208	8	Cockfield	9-28-62	1,070	8.2	9.4	3.4	12	396	1,020	10	2.0	.3	2.1	78	Do
J1	do	1,715	20	Sparta	12- 7-62	762	8.2	15	.37	5	294	704	.0	44	1.1	.0	90	Do
K13	J. P. Boler	1,128	--	Cockfield	3-15-62	955	8.2	10	.22	6	350	888	2	29	2.4	.0	74	Do
M2	Vicksburg Municipal Airport	960	--	do	3-20-62	1,990	8.9	4.9	.11	14	787	1,170	16	320	0	.5	71	Do
Q1	R. G. LeTourneau Co.	1,100	--	do	3-20-62	4,870	8.6	7.0	.26	65	1,910	862	3.6	2,380	3	.2	72	Do
							WEBSTER COUNTY											
D2	J. E. Skelton	1,450	--	Eutaw	7-20-61	676	7.9	11	0.00	10	259	478	0.6	141	1.9	0.7	--	USGS
E2	H. I. Hill	1,120	6	do	6-10-60	520	8.0	5	.09	14	182	348	1.4	95	.8	1.3	--	Do
E3	Natchez Trace Parkway	1,753	20	Gordo	6-10-60	471	7.1	3.5	.07	52	149	136	.0	190	.0	1.0	--	Do
H3	Town of Eupora	190	75	Wilcox	11- 4-60	176.39	7.5	10.6	.7	110.4	[b] 25.76	156	1.65	7	.2	--	--	MSBH
H4	do	175	99	do	1-18-57	170	8.3	17	.28	20	46	133	.8	4.5	.1	.3	63.5	USGS
H6	do	173	202	do	6-10-60	142	7.1	17	1.0	24	22	90	.0	2.0	.0	.2	65	Do
H11	Town of Walthall	2,410	150	Gordo	11-30-66	770	7.5	15	.23	34	283	248	.2	334	.8	.1	90	Do
H12	Sapa Water Assoc.	2,300	167	do	11-30-66	789	7.2	16	.41	53	285	175	.8	378	.4	.1	89	Do
J2	D. Stewart	1,486	--	Eutaw	7-20-61	1,070	8.1	10	.10	22	394	638	10	248	4.3	1.5	--	Do
J3	Wood Junior College	1,720	11	do	3-19-62	962	7.8	11	.72	24	346	538	2.2	234	3.6	1.1	--	Do
K5	Cumberland School	1,380	--	do	10-22-58	806	8.1	4.6	.61	18	304	558	.4	160	3.5	2.6	74	Do
							YAZOO COUNTY											
C1	Jack W. Pepper	897	3	Sparta	8-10-59	198	8.0	29	--	32	33	114	6.8	4.5	0.4	2.2	--	USGS
C2	Clayton Saxton	417	--	Cockfield	5-29-59	206	7	--	2.8	108	17	138	13	14	.1	.1	70	Do
C8	C. C. Swayze	1,682	--	Tallahatta	5-29-58	329	8.5	--	.02	6	122	308	1.2	4.0	.3	1.2	81	Do
C9	W. N. Heidel	760	--	Sparta	6- 3-58	229	7.8	--	.32	6	62	148	12	7.0	.0	2.5	67	Do
M15	D. F. Berry	1,772	--	Tallahatta	3- 3-58	1,233	8.1	2.4	.0	2	[b]536	--	.0	2.0	4.0	--	--	Do
N3	H. C. Oates	1,159	--	Sparta	5-28-58	231	7.7	--	.24	4	66	156	17	5.0	.0	1.2	72	Do
N4	Lee Fox	433	--	Cockfield	5-28-58	203	8.1	--	.55	103	23	172	3.2	8.0	.1	1.1	73	Do
S1	C. L. Ertle	1,065	--	Sparta	4-21-60	--	7.5	--	.4	6	--	33	--	--	--	--	--	Do
S4	Clarence Vanderber	1,000	--	do	4-21-60	--	6.7	--	.1	6	--	54	--	--	--	--	--	Do
W2	Town of Bentonia	621	--	Cockfield	8- 5-59	262	7.3	6.8	.3	4	[b]103	212	36	10	.1	--	--	Do
W13	do	640	100	do	4-13-64	271	7.7	24	--	3	98	212	26	8.5	.0	.1	71	Do

[a]USGS is U. S. Geological Survey; MSBH is Mississippi State Board of Health; MCL is Mississippi Chemical Laboratory.

[b]Sodium and potassium reported as sodium.

Table 3.--Duration of flow of the Big Black River at Pickens, Bentonia, and Bovina
(Adjusted to period 1929-57 by comparison with long-time records.)

Reference No. (fig. 14)	Station	Drainage area (sq mi)	Flow in cubic feet per second, which was equaled or exceeded for indicated percent of time																
			99.5	99	98	95	90	80	70	60	50	40	30	20	10	5	2	1	0.5
44	Big Black River at Pickens, Miss.	1,460	37	42	48	62	85	136	208	326	540	910	1,600	2,800	5,000	7,600	11,700	15,200	19,200
57	Big Black River near Bentonia, Miss.	2,340	58	64	74	96	130	208	320	500	860	1,480	2,480	4,350	7,900	11,800	16,800	20,800	25,800
66	Big Black River near Bovina, Miss.	2,810	70	78	90	116	157	250	388	610	1,030	1,790	3,050	5,300	9,600	14,400	20,600	25,500	30,800

Table 4.--Chemical analyses of water from streams in the Big Black River basin.

(Constituents are in parts per million)

Date of collection	Discharge[a] (cfs)	Silica (SiO_2)	Iron (Fe) in solution at time of analysis	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color	Temperature (°F)
															Total	Noncarbonate				
Hays Creek near Vaiden--No. 19 on map (fig. 14)																				
11-13-59	5.54	10	0.32	8.6	5.3	20	5.0	45	0	30	16	0.2	2.6	132	44	6	197	6.8	25	--
Indian Creek at West--No. 27 on map																				
11-20-59	1.08	11	0.65	2.9	2.5	8.0	2.3	24	0	8.0	7.5	0.2	0.7	87	18	0	81	6.7	30	--
6- 1-60	.78	3.8	.13	4.1	3.4	12	1.1	30	0	16	8.0	.1	.4	78	24	0	111	6.6	5	77
Spring, draining to Apookta Creek--No. 28 on map																				
2-13-57	[b]0.01	--	0.02	2.4	2.7	5.6	0.4	15	0	1	12	0.2	0.5	32	17	4	60	7.1	--	--
Tributary of Apookta Creek--No. 30 on map																				
9-18-62[c]	[b]3	--	--	--	--	--	--	--	--	--	2.4	--	--	--	10	--	<50	6.6	--	--
Big Black River at Durant--No. 33 on map																				
10- 4-62[c]	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	20	--	60	6.8	--	72
Spring, at Castalian Springs--No. 34 on map																				
10- 4-62[c]	[b]0.01	--	--	--	--	--	--	--	--	--	8.4	--	--	--	15	--	<50	<6.0	--	--
Bogue Falaya Creek (Long Creek)--No. 37 on map																				
9-21-62[c]	--	--	--	--	--	--	--	--	--	--	3.4	--	--	--	10	--	<50	6.7	--	73
Lake at Holmes County State Park--No. 35 on map																				
10- 4-62[c]	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	20	--	60	7.1	--	74
Seneasha Creek--No. 43 on map																				
9-21-62[c]	--	--	--	--	--	--	--	--	--	--	2.4	--	--	--	15	--	<50	6.6	--	73
Big Black River at Pickens--No. 44 on map																				
2-13-58	3,000	7.4	0.35	4.6	1.4	5.1	1.9	20	0	7.8	4.5	0.5	0.8	44	18	1	65	6.7	20	45
6-10-58	340	8.6	.04	6.9	1.6	5.6	2.7	21	0	8.2	6.0	.5	1.9	52	24	6	78	6.4	22	84
10-22-58	179	4.6	.49	4.9	3.0	6.5	1.4	34	0	4.6	6.2	.0	1.0	50	24	0	87	6.8	5	65
9-10-62	123	9.8	.16	3.4	1.6	5.8	1.8	22	0	5.2	4.2	.0	.2	43	15	0	66	6.4	40	84
10-29-62	106	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70	--	--	62
1-10-63	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	--	--	47
1-21-63	740	7.6	.47	3.0	1.3	5.3	1.5	15	0	5.8	4.4	.1	.8	37	13	1	57	6.4	120	--
2-27-63	768	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	--	--	45
4- 2-63	376	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--	70
5- 9-63	260	8.9	.04	4.9	1.9	6.0	1.6	22	0	8.4	5.7	.1	.2	43	20	2	75	6.3	20	76
5-29-63	933	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--	70
9-18-63	167	8.8	.18	3.0	1.6	6.7	2.1	17	0	6.6	7.5	.1	.2	45	14	0	68	6.0	60	77
10-14-63	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--	73
2- 6-64	920	13	.25	4.3	1.0	6.2	1.9	14	0	10	6.3	.2	.4	51	15	4	68	6.1	100	48
3- 9-64	9,540	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--	48
4-23-64	2,660	10	.06	3.3	2.6	4.8	1.8	23	0	5.4	4.1	.1	.5	44	19	0	65	6.8	30	72
6- 3-64	507	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	125	--	--	71
9- 9-64	110	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	76
9-28-64	84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	--	--	77
12- 4-64	1,150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	55	--	--	50
12-17-64	2,680	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<50	--	--	49

5-29-63	933	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--	70
9-18-63	167	8.8	.18	3.0	1.6	6.7	2.1	17	0	6.6	7.5	.1	.2	45	14	0	68	6.0	60	77
10-14-63	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--	73
2- 6-64	920	13	.25	4.3	1.0	6.2	1.9	14	0	10	6.3	.2	.4	51	15	4	68	6.1	100	48
3- 9-64	9,540	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--	48
4-23-64	2,660	10	.06	3.3	2.6	4.8	1.8	23	0	5.4	4.1	.1	.5	44	19	0	65	6.8	30	72
6- 3-64	507	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	125	--	--	71
9- 9-64	110	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	76
9-28-64	84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	--	--	77
12- 4-64	1,150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	55	--	--	50
12-17-64	2,680	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 50	--	--	49
1-19-65	672	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	40
4- 1-65	6,900	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 50	--	--	51
5-18-65	173	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	120	--	--	76
6-16-65	455	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70	--	--	76
8- 3-65	155	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	65	--	--	86
9- 8-65	118	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	82
10-13-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70	--	--	63

Doaks Creek near Canton at Highway 51--No. 52 on map

11-13-59	22	9.7	1.4	5.1	2.7	6.8	1.7	25	0	9.6	8.0	0.1	0.6	58	24	3	87	6.8	35	--
6- 1-60	22	3.5	.00	6.5	2.9	8.0	1.7	29	0	12	8.0	.0	.5	57	28	4	102	6.9	15	75

Big Black River near Bovina at Old Highway 80--No. 66 on map

10-20-58	392	4.6	0.55	8.6	4.9	12	3.6	52	0	6.8	14	0.1	0.9	82	42	0	144	7.0	5	--
7-17-59	9,980	1.5	.07	4.4	1.8	5.2	3.9	20	0	7.6	6	.2	.2	41	18	2	67	6.4	5	59
6-25-59	586	2.8	.42	11	4.7	11	2.6	56	0	7.6	12	.1	1.7	82	47	1	151	6.9	80	--
10- 2-61[d]	--	10.8	--	19	3.0	40		47	--	5.9	67	--	--	174	61	--	--	7.0	--	--
10-30-61[d]	--	6.8	--	23	3.1	40		61	--	7.1	62	--	--	178	70	--	--	7.3	--	--
11-27-61[d]	--	25.2	--	4.8	.9	7		13	--	4.9	9	--	--	60	16	--	--	6.4	--	--
10- 3-62	154	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	155	--	--	72
12- 3-62	245	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	140	--	--	56
1-16-63	751	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	340	--	--	40
2-25-63	1,960	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	96	--	--	46
4- 3-63	595	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	185	--	--	70
5-13-63	327	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	225	--	--	82
5-31-63	210	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	290	--	--	80
6-20-63	142	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	285	--	--	82
8-16-63	378	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	135	--	--	82
1-30-64	5,670	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70	--	--	68
6- 9-64	473	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	170	--	--	70
7- 1-64	529	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	--	--	72
9-24-64	149	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	360	--	--	80
12-14-64	7,610	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	--	--	52
3-23-65	4,050	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	57
4-26-65	1,480	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	140	--	--	74
6- 2-65	382	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	265	--	--	--
9- 2-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	220	--	--	84
10-12-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	160	--	--	71

Big Black River near Port Gibson at Highway 61--No. 80 on map

6- 3-61	--	5.2	0.11	27	6.5	11	2.3	83	0	30	16	0.2	0.4	140	94	26	250	6.8	80	--
7-12-61	--	8.2	.32	10	3.2	29	2.9	32	0	6.0	51	.2	.5	127	38	12	226	6.4	140	--
8-15-61	--	6.7	.51	8.1	2.9	27	3.4	29	0	5.8	47	.2	.7	173	32	8	230	6.4	120	--
9- 8-61	--	7.3	.32	9.1	3.0	16	3.9	34	--	5.6	28	.2	.5	91	35	7	161	6.8	210	--
10-19-61	--	5.9	.00	21	8.2	55	3.9	82	--	7.8	96	.2	1.4	256	86	19	445	7.2	10	--
10-27-61	--	8.7	.00	22	6.6	40	2.4	95	--	6.8	62	.2	.2	200	82	4	354	6.8	20	--
11-29-61	--	7.0	.34	17	6.5	18	2.4	78	--	7.2	28	.1	.2	142	69	5	234	6.7	50	--
8-12-65	443	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	230	--	--	81
8-27-65	467	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	325	--	--	--
10-19-65	241	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	205	--	--	72
11- 2-65	139	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	260	--	--	60
11-30-65	212	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	320	--	--	58
1- 5-66	2,300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	270	--	--	54

[a]Discharges reported are either daily mean discharges or discharges for the time when samples were collected, computed from a stage-discharge relation or from a measurement.

[b]Discharge estimated.

[c]Field analysis.

[d]Analysis by Mississippi State Board of Health.

BIG BLACK RIVER, MISSISSIPPI
COMPREHENSIVE BASIN STUDY

Annex G
Archeological, Historic and Natural Resources
of the Big Black River Basin, Mississippi

Prepared by
National Park Service
Southeast Region, P. O. Box 10008
Federal Building
Richmond, Virginia
April 1968

CONTENTS

INTRODUCTION

The basic information for the appraisal of the Big Black River Basin was secured by the National Park Service through a cooperative agreement with Robert S. Neitzel, formerly Chief Curator, Mississippi Department of Archives and History.

The following report briefly describes the important elements of the natural setting which helped shape the human occupation patterns. It summarizes the general history of both the Indian and non-Indian settlement as it occurred in the basin or in areas which relate to the basin. The report also summarizes and evaluates archeological resources as they are presently known.

In general, no significant biotic communities or geologic phenomena were noted for the area under study. Neither were there reported any significant surviving historic resources which might be adversely affected by the proposed development. There also would appear to be no conflict between known archeological sites in the Big Black River Drainage area and projected plans for channel straightening. Most of the sites are isolated and scattered in wooded and sparsely settled uplands. Other sites have already succumbed to modern progress or to natural erosional processes.

I. Natural Features

Geography

The entire state of Mississippi lies within the Gulf Coastal Plain Province. With the exception of the Mississippi alluvial valley and the loess hill deposits, the exposed formations through which the Big Black flows are of Pliocene and earlier geologic times. It drains all or parts of Claiborne, Warren, Hinds, Yazoo, Madison, Attala, Holmes, Carroll, Montgomery, Webster and Choctaw Counties.

The stream rises from several sources in Webster County and flows southwesterly for approximately 155 miles to its juncture with the Mississippi River near Grand Gulf. This is approximately 25 miles below the mouth of the Yazoo at Vicksburg. The course is generally parallel to that of the upper reaches of the Pearl River, which flows approximately fifteen miles to the south.

It also runs approximately parallel to the range of loess hills lying the same distance to the northwest. These hills form the eastern limits of the Yazoo-Mississippi flood plain.

The Big Black study basin is included in the North Central Plateau geological subdivision which includes all of North Central Mississippi. The basin is bordered by the Jackson Prairie on the southwest. The stream cuts through the loess hills downstream to join the Mississippi.

The Plateau is a maturely dissected rolling hill country. Red to yellow clays and silty loams have developed out of the deposits overlying the Wilcox group of Tertiary beds. The average upland elevation toward the source ranges between 400 and 600 feet m.s.l. and descends to 100 feet at the mouth near Grand Gulf. The Jackson Prairie, also a rolling landscape of yellow and red clay soils with a brown loam overlay, bounding the Southwestern edge of the study basin is not as rugged as the Plateau.

The Loess Hills occupy the extreme southwest portion of the basin in Warren and Claiborne counties. The stream has had to cut its way through this range in order to find an outlet into the Mississippi. The most prominent feature of the loess topography is extreme relief. High rounded hills and steep valleys are typical. The stream valleys provide small level areas suitable for cultivation.

The loess formation is of Pleistocene age and it has been shown to be at least fifty feet thick where it borders the Mississippi flood plain. The width of the range varies. At the latitude of Vicksburg it is approximately thirty miles wide, feathering out to the east. Numerous springs formerly occurred at the base of the formation where it rests upon the consolidated Pliocene beds. The loess itself is extremely pervious and supports an abundant forest growth and readily absorbs the relatively heavy rainfall. It is a fine velvety soil, with a narrow range of grain size and a high lime

content. Many lime concretions and shells of land snails occur in it. Once the lime is leached out, the formation is extremely susceptible to erosion. As this cohesiveness is lost, old trails and roads become deeply intrenched from the combined effects of traffic and weathering. The standing vertical banks of road cuts are familiar sights in the region.

It has become customary in most geological discussions of this unique formation to pass it off rather glibly as a Pleistocene eolian deposit. Whether it is a wind or water deposit is a matter of conjecture among responsible geologists. Russell (1944) and Fisk (1951), eminent authorities for the lower Mississippi valley are inclined to believe that it is water despoited. Historically and sociologically it has been the foundation of the early riverfront agricultural civilization exemplified by the antebellum culture of the Natchez district.

The Big Black River is a narrow rather deep stream, intrenched in a valley averaging 22 miles wide. The valley broadens gradually southwest of Holmes County. The flood plains of the Big Black and its tributaries occupy about 10% of the 3,300 square miles of the watershed. The stream is about 90' wide for most of its course but widens to 250' near the mouth. The bank height above normal low water ranges between 15' toward the source to 25' in the lower course.

It is interesting to quote one of the few historical descriptions written about the stream. It is by a Captain Mathew Phelps who explored the region shortly after 1773. The description is from his journal and is contained in J.F.H. Claiborne's history.

> "..... From Stoney River (Bayou Pierre) to the Big Black (Chittaloosa) is ten miles. The river at its mouth is usually about thirty yards wide, but widens to forty and fifty yards, and is said to be navigable for small boats thirty or forty leagues."

Other historical evidence tells something about its size. In the January 31, 1836 issue of the newspaper, The Mississippian, published in Jackson, the following item appeared:

> "The steamboats Alice Maria, A. Irwin Jr. Master, and the steamboat Camanche, Brown Master, will run the ensuing season from New Orleans to Amsterdam and Bridgeport on the Big Black. The patronage of the citizens of Jackson and its vicinity is respectfully solicited."

These communities no longer appear on maps of Mississippi.

The broad bottoms and adjacent loamy hill lands attracted settlers from the earliest times. Small springs and the narrow bottoms of the few inconsequential tributaries were added attractions and occasionally significant historical events are associated with the various localities.

Biology

The biota of the region are divisible ecologically into two groups; species associated with forested upland hill land and those with a

preference for the mixed hardwood of the swampy floodplains.

The forests of the uplands consist of mixed hardwoods and pines and the bottoms grow oak, hickory, poplar, tupelo, gums and cypress. Many associated varieties of shrubs and bushes are interspersed through both groups. Animal life consists of deer, wildcats, rabbits, squirrels, raccoon, oppossum, skunks, beaver and both upland and aquatic birdlife in abundance. Formerly bears, panthers, bison and probably elk could be found at will.

Alligators were formerly quite numerous in the lower part of the area, but are practically extinct at present, though one was captured in the Big Black about two years ago. Fish are represented by buffalo, gar, catfish, bream, bass, crappie, goggle eye and some fresh water drum. Bull frogs are hunted extensively for sport and market.

Small farm row crop agricultural techniques following initial land clearing contributed largely to extensive erosional destruction of the basin lands. The flora and fauna suffered accordingly. Economic pressures which made the small farm economy impractical with resultant abandonment of much of the land instituted a natural cycle of restoration.

II. History

French Activities

The study basin lies far to the south of the presumed route taken by DeSoto's army in 1541-2. However, after that army had returned from a hapless foray as far west as Texas, boats were constructed and left the region by way of the Mississippi River.

A hiatus in the historical record of nearly 140 years occurred before the explorations of LaSalle on the Mississippi are recorded. European contact was not extensive from 1682 until 1700, but after this time, French traders, settlers, missionaries and soldiers increase in numbers and influence. The main settlements were on the Mississippi gulf coast, at New Orleans and Natchez. There was also an important outpost at Nachitoches, Louisiana on Red River. There is no record of exploration or activity by the French in the Big Black basin proper. Missionaries, soldiers and woodsmen lived among the remnant Indian tribes of Tunica and Yazoo on the Yazoo River north of Vicksburg. Historic Natchez pottery and European trade goods have been found with burials in the Glass community south of Vicksburg near the mouth of the Big Black. The sites are on the loess hills.

By 1716 the French had exploited the Natchez and other tribes to the point that Fort Rosalie was built and garrisoned at Natchez and Fort St. Peter was projected near the Yazoo tribe. A garrison was maintained there, but it is not certain that a fort was actually constructed.

The French also tried to improve and maintain good relations with the populous Choctaw nation who had control of most of the land in the present state of Mississippi east of the Natchez-Vicksburg districts. There is scattered evidence of late Choctaw occupation on the upper reaches of the Big Black, but the manifestations are not impressive.

English traders from the Georgia colonies had penetrated into what is now northeastern Mississippi and were active among the Chickasaws. French efforts were directed at preventing this influx and was at the core of their diplomacy with the Choctaws.

The situation at Natchez deteriorated meanwhile between 1716 and 1729 when the frustrated Indians massacred or took prisoner most of the French settlers and garrison at this post. Figures are vague, but possible 250 people were killed and perhaps 200 taken captive.

Eventually the Natchez released the prisoners through the intervention of the Choctaws. The Natchez escaped to Louisiana in the early part of 1730 and were pursued and besieged a year later by Perier, the French governor, at Sicily Island. Most of them were taken captive

through deception and were sold into slavery in Santo Domingo. A few escaped and sought shelter among the Chickasaw which was an additional stimulus to the French desire for vengeance against the Chickasaws and their English allies. The French, under Bienville and D'Artaguette, were severely defeated, in 1736. Later Bienville sent another expedition via Memphis to offset the loss. The Chickasaws promised to give up their English Allies and cooperate with the French.

English and Spanish Influences

Meanwhile, distant events in the Georgia colony were fomenting, which would have profound significance in the Natchez-Vicksburg district. The Georgia colony's charter stated that their lands extended from the Atlantic to the Pacific, though no one comprehended the vastness of this region. The Georgia legislature created a County of Bourbon in 1785, which included part of the Natchez district as well as land to the east. The charter claim was not very good because of the vagueness of the terms, the size of the area and the fact that much of the land was already occupied by the Spanish and governed by them. The Georgia appointed officers couldn't enforce their rule.

The Georgia legislature now proceeded to sell this land that wasn't theirs to three large real estate companies. All of North Mississippi went to the Virginia company, northern Alabama to the Tennessee

company and the Natchez District and much of middle Mississippi to the South Carolina-Yazoo company. Regardless of the fact that much of this territory was already owned by Spanish settlers, land offices were opened in Georgia to begin the sale of lands which were to be taken by force if necessary. Use of troops was prevented by the national government and the companies refused to pay for their acquisitions and the project fell through.

Ten years later in 1795, a concerted plan was carried out by four companies to acquire this land from the Georgia colony. They got the Spanish authorities to agree to having the section set up independent of Georgia under Spanish protection after the land was sold to individuals. The arrangement was weak and didn't last. The new United States interfered with the scheme and the sales agreements were destroyed again.

For some time the United States had been attempting to establish an official boundary between Spanish and United States holdings at the 31st parallel of north latitude a few miles north of Baton Rouge, Louisiana. Spain had become weaker as an international power and was not able to resist this federal demand.

The treaty of San Lorenzo was signed in October, 1795, establishing the 31st parallel as a boundary running from the Mississippi River to the Chattahoochee River. All Spanish posts, such as Fort Nogales

at Vicksburg and the fort at Natchez were to be removed within six months and All Americans living south of the line would move to the north of it and the Mississippi River was to be free to the commerce of both Spanish and Americans. The Spanish had formerly claimed 32° 28' North Latitude as the boundary. This included Vicksburg and the Big Black basin. The region between the two parallels was referred to as West Florida. First explored in part by DeSoto, then acquired by France as a colony it passed to England by the Treaty of 1763. The lands west of the Mississippi were given to Spain for aid to the French in the recent wars.

Lands in the district were allotted to soldiers as a reward for their services to England and the colonies during the French and Indian Wars. Large acreages were also sold to settlers at low cost. Many tracts were authorized at from 5,000 to 10,000 acres.

Liberal land policy encouraged large numbers of immigrants from the maritime colonies. Tobacco was the first important crop raised. Later, Indigo and cotton became more profitable.

After England's loss of east and west Florida to Spain, in 1783, at the culmination of the Revolutionary War, the American colonies became the United States and the various boundary disputes were ultimately resolved and the region became United States Territory, a step toward statehood. Strictures with Spanish government were severe. Napoleon

was in power in Europe and Spain in her weakened state turned over all of Louisiana including New Orleans to France. Napoleon, needing money for his European campaigns, sold the vast Louisiana tract to the United States in 1803. As late as 1810, Spain still owned a strip of land south of the 31st parallel and east of the Mississippi along the gulf coast. The Americans living in the region attacked the Spanish post at Baton Rouge and requested admission to the United States as the state of West Florida. The land was soon made a part of the Mississippi Territory. During the development of the Mississippi Territory and the release from Spanish rule, a number of prominent people served as governor of the loosely knit territory. These included Winthrop Sargent, W.C.C. Claiborne, Robert Williams and David Holmes. It was during Williams term, 1807, that Aaron Burr attempted his ill defined plan. His objective was never clear and he was acquitted of charges of a crime against the government. He maintained a riverside camp opposite Bayou Pierre a few miles below the mouth of the Big Black prior to his apprehension.

Many of the settlers in the Natchez District moved to the region prior to the American Revolution, and were sympathetic to the British cause. The rebellion was a remote affair to the frontier people. Many settlers of royalist persuasion abandoned their homes on the seaboard to seek tranquillity in the interior. After the American cause developed strength the Natchez district settlers could no longer

disregard the eastern war and many strictures developed between representatives of the American forces and suspected loyalist settlers.

Indian troubles especially in the present Alabama area, with the Creeks and the Seminoles, were a serious problem in the early 19th Century. Spanish encouragement was suspected to be at the root of the uprisings. General Claiborne with Mississippi Volunteers and Choctaw allies and General Andrew Jackson were successful in defeating the forces aroused by the Chief Tecumseh.

The Federal Period

The war with England or the War of 1812 had a profound effect upon the frontier settlements. Forces from Mississippi and neighboring territories were successful in defeating the British in the Battle of New Orleans, though a peace treaty had already been negotiated, the frontier forces put a definite end to the struggle which had ranged from Washington, D. C. to the Great Lakes.

Following this disturbing period more settlers took up claims in the region and more mature political growth manifested itself in the development of counties. Claiborne in 1802 and Warren in 1809, were the two earliest counties to be formed in the Big Black Basin. Treaties with the Choctaw, Chickasaw and Creek tribes were negotiated to gain a right of way through the Indian lands to accomodate the

throngs of overland settlers. The Natchez Trace of the Big Black drainage was the first of these.

Also at the opening of the 19th Century, the first newspaper was published and Jefferson College was chartered by Congress at Washington, Mississippi. By 1810, there were seven newspapers in the Territory.

By 1817, the present state of Alabama was separated from Mississippi and the Western district became the twentieth state of the Union.

The Constitution of 1817 organized the fourteen counties into a legislative whole. A series of treaties with the Indians resulted in the accession of vast land areas to be opened up for white settlement. The Indians were to be moved ultimately to lands west of the Mississippi. Much of the land in the Big Black basin was acquired by the treaties of Doak's Stand and Dancing Rabbit. After the former negotiated in 1820, by Andrew Jackson and Thomas Hinds, the capital of the state was moved from Washington to Jackson.

Settlers moved into the state in such a hectic fashion that the treaty commissioners had difficulty setting the lines to prevent encroachment. Many early settlements were made along the Big Black. One small almost extinct community in Warren County was named Big Black after the river. By 1807, there were filings for 2090 claims on the Yazoo and Big Black. Settlers in the Rocky Springs area were asked to

restrain themselves until Indian cession lines could be established. The Indian commission was also dissatisfied with the survey marks near the mouth of the Yazoo, because of shift in the river channel. It was necessary to retrace the line from early marks on the Big Black to establish the base of the first survey.

The influx of settlers to the new state and the difficulties attendant upon establishing the myriad of claims attracted a special class of people. These were the lawyers who found abundant work in handling the disputes and litigation that arose. Many men of national importance emerged from this class.

From this early period of statehood until the start of the Civil War, the history of the state is concerned with economic and cultural growth consolidating each new gain into a more mature and efficient political structure.

The most important religious sects during the French and Spanish periods was Catholic with an intrusion of predominantly Episcopal protestant congregations during the English dominion. There was considerable conflict between these during the subsequent Spanish period. These old formal religions were confined almost exclusively to the wealthy and flourishing Mississippi River counties. Minor sects such as Methodists were insignificant at this early period. As settlers from the Carolinas, Georgia, Tennessee and related areas moved into

the small holding hill land territories, the more fundamental individualistic sects grew among the rural population. Primitive Baptists and related offshoots gained their strength here. As the urban centers developed even the more forbidding of these religious forms mellowed and succumbed to the inevitable tranquillity of organized and well financed religion.

The Big Black Basin being predominantly rural, the Central Plateau hill land population still follows the pattern of the early Calvinistic settlers.

The next significant event to affect the study basin was the Civil War. The siege of Vicksburg is by far the most important event concerned with the region. Federal troops, led by Grant and Sherman, bypassing the bluff city, were crossed to the Mississippi side from Louisiana in the vicinity of the Big Black near Grand Gulf. The line of march was from there to Port Gibson, Raymond and ultimately Jackson. The Confederates retreated westward, crossed the Big Black and during the battle succeeded in destroying the main bridge there. This hampered the federal pursuit and the Confederate forces took refuge in the Vicksburg defenses under Pemberton. Yazoo City had a naval yard where the Confederate ram Arkansas was built and launched.

An early archeological survey report also states that guns were mounted upon an Indian mound some distance up from the mouth of the Big Black.

Apparently this was to forestall attacks by gunboats, though the navigability of the stream at the time is questionable.

The Reconstruction Period in the Big Black drainage was apparently neither better nor worse than similar regions throughout the south. Destruction naturally occurred. The scattered rural population offered little of value or interest to the invading armies.

III. Archeology

General

Very little organized archeological research has been carried out in the state of Mississippi. The study area has received some attention by various persons or institutions. Desultory digging was done in sites in Jefferson and Claiborne counties during the late 19th Century. C. B. Moore did some digging in Warren and Yazoo counties in the early part of the 20th Century and reported his findings. The Mississippi Department of Archives and History sponsored field survey work and excavation of several sites in Yazoo, Hinds and Madison counties. Most of these were small burial mounds associated with the upper course of the Big Black River. Two separate cultural occupations seem to have been represented at the sites. Village sites are mainly absent or so thin as to be difficult to locate. Late Troyville (Deasonville-Baytown)

Coles Creek, Plaquemine and Mississippi manifestations are represented. Marksville and Poverty Point sites occur in the alluvial plain of Yazoo County.

The Harvard Lower Yazoo Basin survey did work near Vicksburg and extended their exploration north into the neighboring delta. Some of this investigation has been published and the remainder is in manuscript.

Considerable destruction has occurred through normal agencies of agriculture and erosion. Some looting has occurred, but for the most parts the sites were so inconsequential, there has not been much activity along this line.

The most conspicuous and best preserved site that might be recommended for research and development is the temple mound and associated village site at Pocahontas, Mississippi in Hinds County. A small burial mound associated with this site lies about one-quarter of a mile to the northeast. This has been partially destroyed by early digging, but may yield some results. At present the site is a roadside park and is well preserved.

Seventy-nine aboriginal sites were catalogued in the Big Black River drainage area. Eighteen were in Yazoo County alone, with lesser numbers from the other counties. For the most part, these occupy small creek

valleys and adjoining highlands with very few being found in Big Black River Valley proper. Most of them are open village or camp areas. Often small burial mounds are near by, but the latter seem to date later than the midden areas.

Though fairly satisfactory collections were made from most of these in the twenties and thirties, it was quite disappointing to find surface material so scarce during the present survey. Five or six plain sherds and possibly some stone fragments were considered a good yield, where perhaps forty to seventy sherds were catalogued by surveys made about thirty years ago. Unfortunately, the early collections have been lost and cannot be re-studied. Quite often reported mounds were not to be found at the present time. In other instances, locations reported as "Indian mounds" were found to be natural eminences with some scant evidence of former occupation.

Possibly ten of the locations were temple mound sites with associated village sites. Approximately thirty-five sites have been identified as burial mounds, one to four at each site, and sometimes with accompanying village sites. Many of these have been excavated by field parties of the Department of Archives and History, others have been destroyed by treasure hunters or the combined forces of agricultural activity and sheet erosion. The latter combination seems to account for the decimation of the village sites. The deposits evidently were

never very deep and cultivation of such hill land sites followed by subsequent erosion has caused them to virtually disappear. Significantly enough, the agricultural activity had ceased many years ago as modern agricultural aims changed and most of the areas have reverted to grass, bushes and trees. Five foot test pits put down at well documented and promising midden areas yielded few or no results. Perhaps more extensive nets of trenches might expose subloil evidence of houses, graves or other evidences of occupation. None of the sites indicated a possibility of stratification, except the rather nebulous sort manifested in the small burial mounds that have been examined.

Road building, farm pond construction and some industrial developments have also destroyed some sites. The changing modern landscape makes it difficult if not impossible to relocate many sites as designated thirty or more years ago. Wauchope has recorded a similar difficulty in his memoir detailing revisits to Georgia sites with which he was familiar some thirty years ago.

The principal archeological works that give some clue to the culture history of the area are the excavations of Ford, Collins and Chambers in the late twenties and thirties and Bohannon and Koehler in the early sixties. Though the early work has been described only briefly, the drawings and typological descriptions fill many gaps to supplement current knowledge. The Harvard Lower Basin Survey also furnishes

supplementary data which aid in understanding cultural overlap and continuity. The work of Cotter, Corbett and Jennings to the northeast of the area also provides valuable additional material. Rand's work at the Wills site in the Pearl River drainage immediately adjacent to the area under discussion, provides an early cultural base upon which to construct a local chronology. Much of this fragmentary data in the literature has been synthesized by Mangum in terms of cultural interpretation developed by the Harvard Lower Mississippi Valley Survey. Ford has published some of the results of early burial mound excavations along the Big Black River. Collins has published limited data on the Deasonville Site in Yazoo County and brief information about historic Choctaw sites to the immediate northeast of the area. Most of this information has been summarized by Ford and some field notes and photographs are in the possession of the Mississippi Department of Archives and History. It is necessary to refer to pertinent cultural information, where available, from areas marginal to the Big Black River locale in order to understand movements of cultures or segments of culture through time and space in that drainage basin. Cultural affinities on the Early to Late Woodland time level are obviously related to the Tennessee and Alabama developments, but cultural exchange of either ideas or people is moving in the opposite direction, expecially in later times from the Delta and Lower Mississippi centers.

Some of the pottery types collected from the surface by early investigators can be identified fairly accurately, although current pottery nomenclature was not in use then. These tend to support and tie in with the published reports of ceramic styles and flesh out the archeological knowledge of the area. Unsatisfactory collections by the present survey were disappointing, because it was hoped that they might help in defining the early descriptions of more adequate collections which described sherds in rather broad terms, such as: "Broad trailed curvilinear designs, rocker stamping, clay sherd or tempered plain sherds, etc." For the most part, these can be identified with Yokena Incised, Marksville or Troyville Stamped, Baytown Plain, Churupa Punctated and Baldwin Plain.

It is obvious from the later work of Bohannon in the Pearl River Basin along the relocated Natchez Trace that the Baytown series is represented, but sand tempered and other plain types of sherds may be aptly referable to Lower Valley Survey types of northwest Mississippi rather than those described by Jennings in Lee County and Cotter and Corbett in Chickasaw County which are definitely connected with the ceramic styles that filtered into northeast Mississippi from Tennessee and Alabama.

The contents of the burial mounds excavated by Ford and Chambers and more recently by Bohannon in the Big Black Valley and along the Natchez

Trace respectively, indicate that these were built by peoples of the Plaquemine and Mississippian cultures respectively. The fill of the mounds contained clay and sand tempered sherds, apparently picked up in basketloads of surface soil. The burials were accompanied by pottery and artifacts ascribable to Plaquemine and Mississippi horizon styles.

Chronology

The local culture chronology may be constructed on a base represented at the Wills Site as mentioned above. This site was excavated by Rands of the University of Mississippi as a salvage project in the Ross Barnett Reservoir on the Pearl River, just to the north of Jackson, Mississippi. As stated previously, the Pearl and Big Black river drainages are contiguous in this area and the site is not far from the Big Black drainage.

It was not a very productive site and the deposit was thin. Evidence consisted of Poverty Point objects overlapped stratigraphically by fiber tempered sherds and Tchefuncte-like pottery. The fiber tempered ware was related to Wheeler Plain and Bluff Creek Punctated. Jaketown Simple Stamped, Lake Borgne Incised, Withers Fabric Impressed and Tammany Pinched were the Tchefuncte types present. Mulberry Creek Cord-marked was found in increasing quantities in the upper levels and a

few Hardy Incised sherds indicated a Plaquemine Period occupation.

No other sites in the two drainages have yielded Poverty Point or Tchefuncte materials, though fabric marked pottery formerly has been found at Wb-1, the Blue Goose Site in Webster County. This occupied an eroded ridge and could not be found by the present survey.

The Marksville horizon is represented, though not very convincingly, by the Shell Ridge or Coody Site (Yz-3) in the southern tip of Yazoo County. Some slight evidence of occupation still exists. Formerly, mussel shells, bone, cordmarked and stamped pottery were found. The latter collected by Ford, consisted of Larto Red Filmed, Mulberry Creek Cordmarked, Plain and Dentate Rocker Stamping and Yokena or Marksville Incised, and possibly some Chase Incised. Marksville Sites are fairly frequent a few miles to the northwest in the Yazoo River drainage and the materials are more typical than found here. An aberrant type of Marksville material has been found far to the north of this drainage by Koehler in Grenada and Yalobusha Counties and by Cotter and Corbett at the Bynum Site in Chickasaw County. The Big Black drainage does not appear to have been popular with Early Woodland peoples.

Troyville Material is found in most of the sites later than this rather specious Marksville horizon, but the characteristic types are not dominant as they are in the Issaquena-Troyville occupations in the lower Yazoo Basin. Instead, types associated with Ford's former Deasonville

complex mixed with a few Troyville sherds, characterize the collections.

Representative types are Larto Red Filmed, Mulberry Creek Cordmarked, Evansville Punctated, Baytown Plain. In addition, bone awls, celts, pitted hammerstones, elbow pipes, pottery discs and large circular house patterns are found in the Deasonville tool kit. Small conical mounds and a village site are found on such sites, but the mounds are not definitely known to be part of the village assemblage. Ford has reported one possible Deasonville Site on Pearl River with a pyramidal mound as well as conicals. No location was given and it cannot be relocated. Red filmed and cordmarked sherds were found there.

The Old Hoover Site (Ho-13) in southeastern Holmes County, has a pyramidal mound and an accompanying village site. Nineteen decorated sherds found there by Ford were Larto Red Filmed, Mulberry Creek Cordmarked, plain and dentate rocker stamping and Yokena or Marksville Incised. This would seem to be a Deasonville Site associated with a pyramidal domiciliary mound.

Coles Creek sites as they are typified in Louisiana and other parts of the lower valley, are not numerous in the Big Black area. The distinctive pottery types occur in a minority in most site collections. Ford's Walker Site yielded a small collection of sherds containing Larto Red Filmed, Mulberry Creek Cordmarked, Coles Creek Incised and

either Evansville or Parkin Punctated. According to Ford, bottles were also found. The site is in the southern tip of Yazoo County, not far from the Big Black River and is probably the same as the Mound Bottom Site (Yz-1) in the present survey. It consists of three small conical mounds and a village site. No collections were made as the area has grown up in grass and briars.

The Plaquemine and Mississippi horizon which are cultural overlaps in this area are best represented by the Pocahontas Site in northeastern Hinds County. It is almost equi-distant between the courses of the Big Black and Pearl Rivers. A large, well preserved pyramidal mound, approximately 25 feet high and 350 feet by 200 feet, stands near U.S. Highway 49. A burial mound, said to have been 10 feet high, lies about one-quarter of a mile to the northeast. Highway construction threatened to destroy the pyramidal a number of years ago, but intercession by the Mississippi Department of Archives and History effected a change so that now the area has become a roadside park. Obviously, there has been some digging into the burial mound as it is hardly four feet high and abutts on an abandoned school building. Formerly, school children collected some objects from it; one tobacco pipe in the Mississippi State Historical Museum represents a kneeling human figure. A pottery vessel representing a bird was also taken from the mound. Material from the temple mound was similar to that from other burial mounds along the Big Black River.

The village site near the pyramidal mound formerly contained quantities of sherds. Surface collections included punctated filled bands (Dupuy Incised), incised scrolls, lugs and handles, Manchac Incised, Barton Incised, Belzoni or Arcola or Leland Incised, Coles Creek Incised, Mazique or Manchac Incised, Baytown Plain deep notched rims, Harrison Bayou Incised, Evansville or Parkin Punctated, Haynes Bluff Rims and Anna Engraved. This assemblage establishes, on the basis of surface collections, the assignment of this site to be Plaquemine-Mississippi horizon. Geographically, it lies on the mythical boundary where Mississippi cultural elements moving southward begin to fade and where Plaquemine cultural influences moving from the south tend to lose strength.

Historic Period Sites

Historic sites are also scarce in the drainage area. It is to be assumed that numerous bands of Choctaw lived in the region in the late 18th and early 19th centuries. According to local tradition in the 1930 surveys, a family taking up land in northwestern Webster County in 1830 ascribed a barren knoll in their holdings to the village of the Chocchuma who, according to local histories, customarily have been exterminated in various localities by the Chickasaw and the Choctaw. The 1930 surveys recovered a few sherds of Chickachae Combed, some with red film, stone objects and mussel shell. This seemed to be a promising

lead since the open or cleared area was unusual for the heavily forested pine land. With some difficulty the site was relocated by the present survey, hopefully to put down test trenches and secure archeological data at a presumed historic site. The knoll was denuded by sheet erosion. Two sherds of a fine sand or shell tempered plain ware were found which are practically the same as the ware of historic Choctaw combed pottery. A small stemmed projectile point and a small clay tempered sherd were also found. Testing revealed no indications in the subsoil of post holes or pits. Choctaw sherds have been found at Pocahontas and along the Natchez Trace.

The French entered the valley in 1682 and by 1730 most of the tribal units had disappeared. Judging from the distribution and depth of the archeological sites in the counties comprising the study basin, the present scattered and sparse population distribution with few urban concentrations is typical of what transpired in prehistoric times. Yazoo county has the most sites spread over a considerable span of time. The largest, denoting sizable towns occur in the delta region. There are none of any consequence in the drainage basin.

The towns of Natchez, Tunica, Koroa, Yazoo, Ofo and Ibitoupa are most frequently referred to in the early travel accounts. The Choctaw, though claiming rights to most of the land in the study basin are seldom brought to the center of the stage in person. All of the groups,

except the Natchez appear to be the last remnants of formerly much larger tribal grouping. Even the Natchez were reputed to have been formerly a larger nation controlling extensive territory. They seem to exemplify the survival of the mound building cultures attributable to the Mississippian cultures that prevailed in the southeastern states for several previous centuries. DeSoto probably saw this cultural peak at its height in various states. The impact of European entry merely hastened a process of deterioration that seems to have been well under way.

After 1800, as the European settlers began to fill up the territory, the remnant bands disappeared. The Choctaw and Chickasaw rapidly adopted the ways of the whites though maintaining some tribal autonomy under strong, influential chiefs. The majority were removed to the Oklahoma Territory by treaty, though a large number of Choctaws refused to leave. Their descendants still live in eastern Mississippi where schools and an agency are maintained.

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